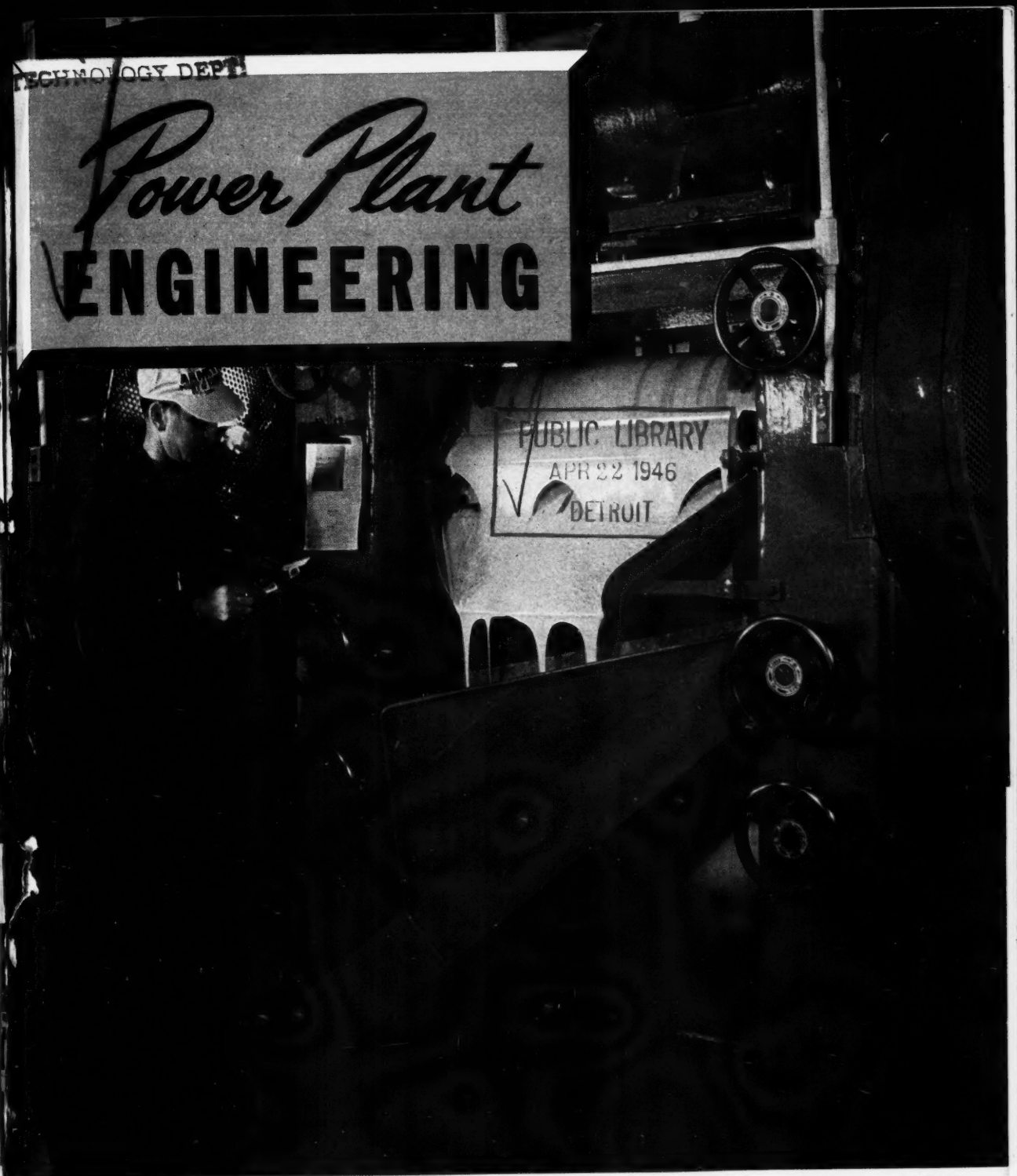
TECHNOLOGY DEPT.

Power Plant ENGINEERING



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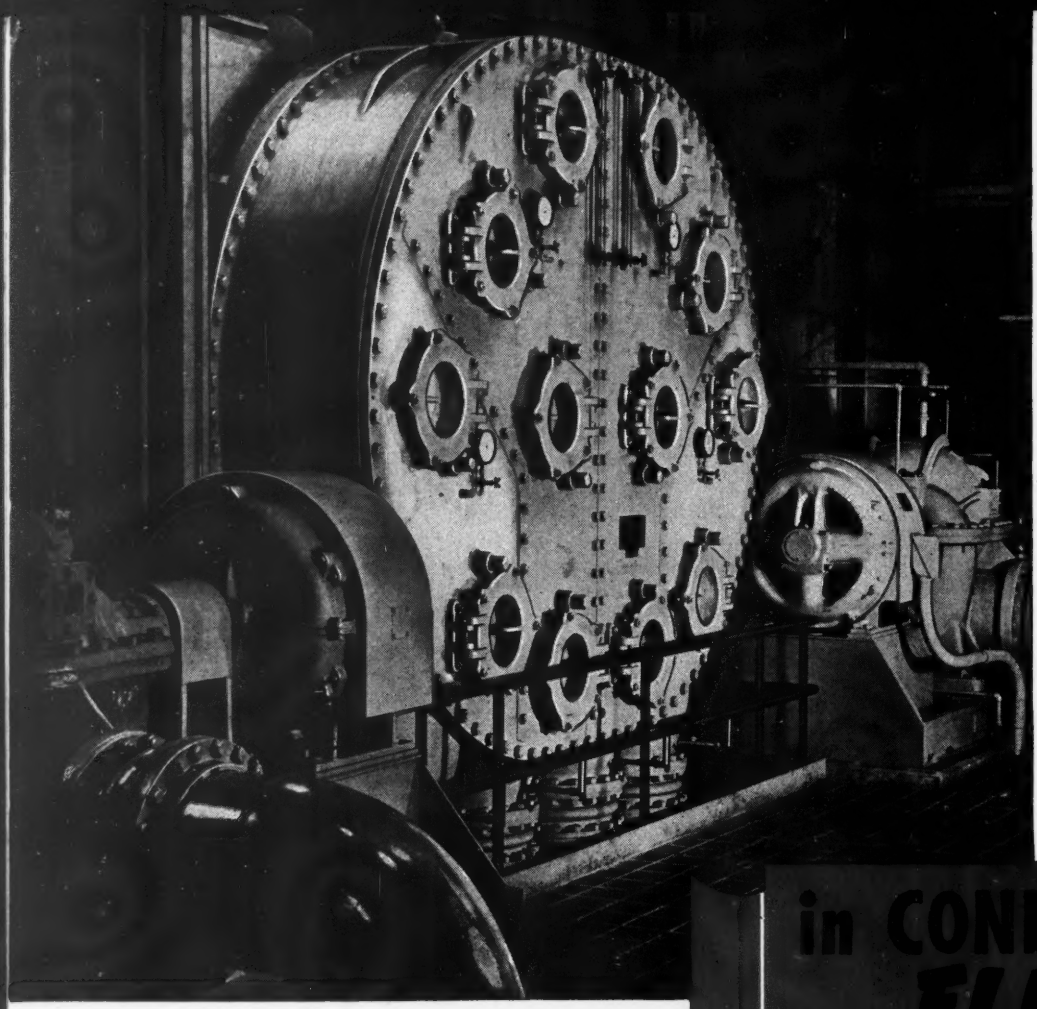
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

APRIL • 1946

Features

ATOMIC ENERGY FOR POWER GENERATION • 100 MILLION VOLT BETATRON • ELECTRONIC EXCITER • MOTOR-DRIVEN AUXILIARIES • HIGH-DIFFERENTIAL MANOMETER • THE POWER PLANT GOES TO SEA • • • • CONTENTS PAGE 5



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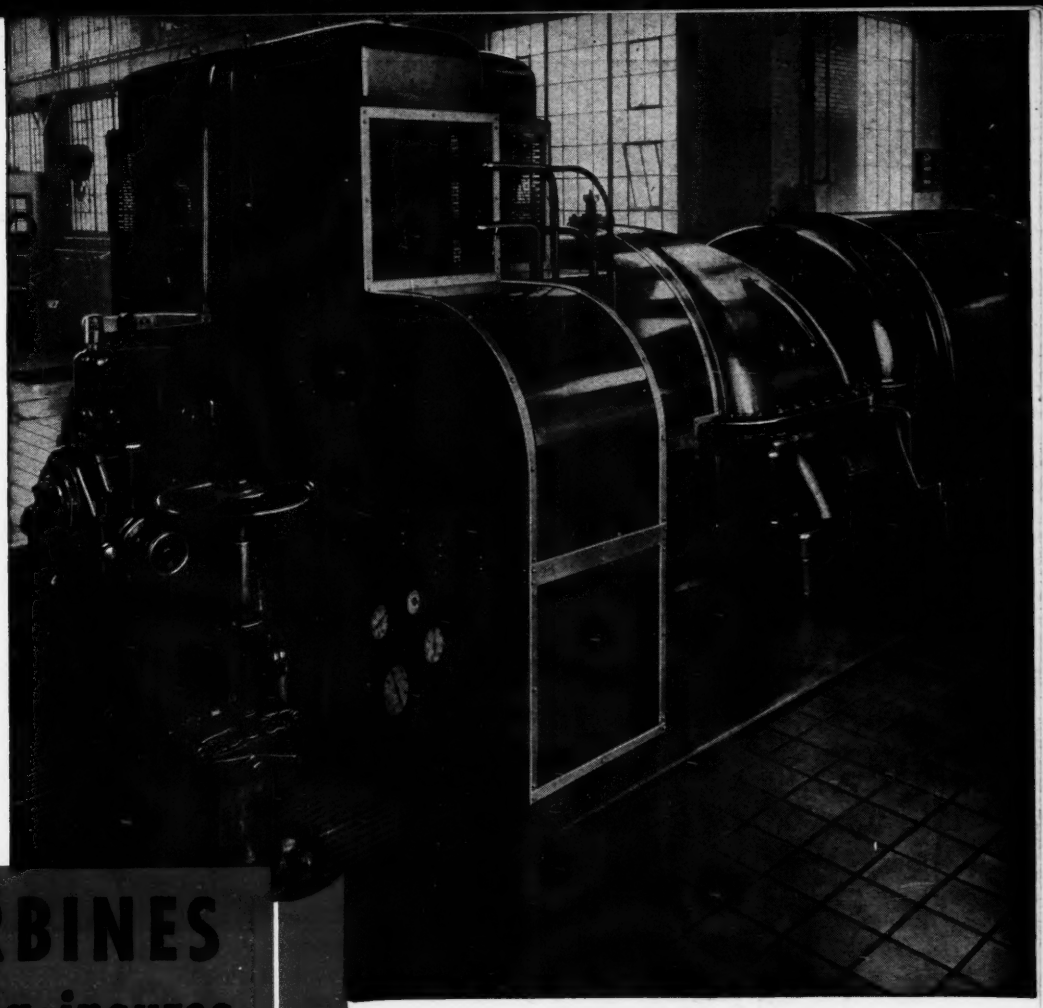
Elliott condensers are "tailor-made" for the installations they serve. Their sound performance is amply demonstrated in many plants.

ELLIOTT



Elliott 6,000-kw turbine-generator unit.

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When you need turbines—either as units with their generators, or for mechanical drive—talk it over with Elliott engineers.

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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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Arthur L. Rice, Jr.
53 W. Jackson Blvd., Chicago 4, Ill.
Harrison 0824

NEW YORK: H. G. Wilds
Graybar Bldg., New York 17, N. Y.
Caledonia 5-3779

PHILADELPHIA: H. G. Wilds
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Subscription Information—The monthly issues are sent prepaid by second class mail. Prices: United States and possessions one year $2.00 and two years $3.00. Canada one year $3.00 and two years $5.00. Other countries one year $4.00 and two years $7.00. Address correspondence about subscriptions to Circulation Manager, POWER PLANT ENGINEERING, 53 West Jackson Blvd., Chicago 4, Illinois. Changes of address should give both old and new address and reach us by 20th of month to be effective with following month's issue. The Annual Index is furnished as a part of the December issue.

Power Plant ENGINEERING

April, 1946

VOLUME 50—NUMBER 4

Cover: Typical of the many power applications in the paint industry is this high speed 5-roller mill at the Armstrong Paint & Varnish Works' plant in Chicago. The 25 hp a-c motor is mounted on the top of the machine, uses a 6-unit V-belt for drive.

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Copyright, 1946, by Technical Publishing Company.

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago 4, Ill., U. S. A. Subscription price, $2.00 a year. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. L, No. 4.

Jenkins PRACTICAL PIPING LAYOUTS 9

How to plan a HIGH PRESSURE STEAM DISTRIBUTING SYSTEM

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

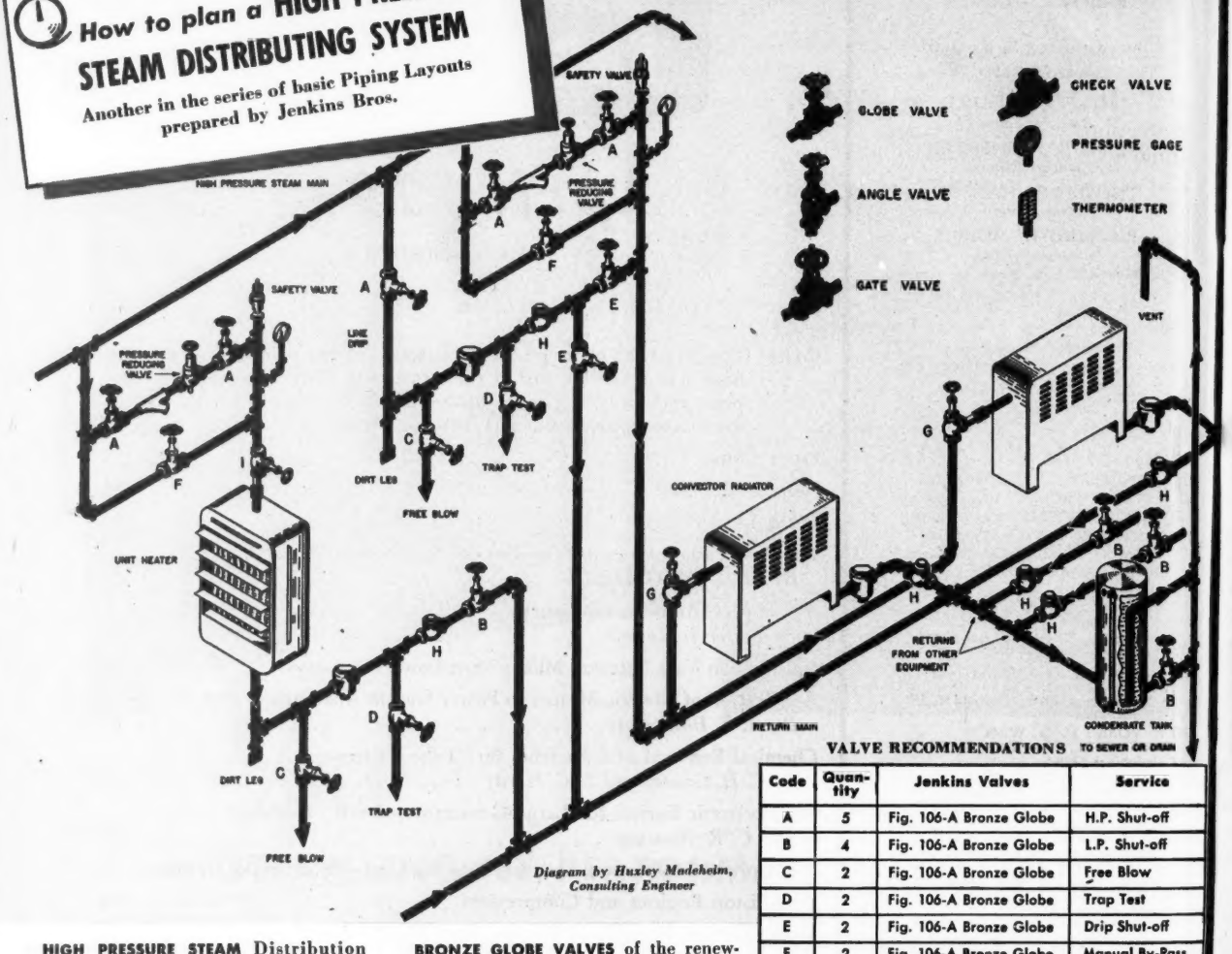

Diagram by Huxley Madeheim, Consulting Engineer

HIGH PRESSURE STEAM Distribution Systems of the type illustrated in this layout are frequently installed for the efficient heating of the sprawling, monitor type industrial plants, covering a large area, which have been built in increasing numbers during the past few years. The hook-up allows for reduced pipe sizes and takes care of excessive pressure drops due to the long distance between the heating plant and the radiation.

SUBSTANTIAL SAVINGS in installation and maintenance costs are effected through the elimination of return lines in many such installations, especially where the heating system takes a small percentage of the steam and treated water. Condensate is collected in vented tanks at the lowest points in the system, and drained off. Check valves prevent back flow from the tanks.

BRONZE GLOBE VALVES of the renewable composition disc type are recommended for all shut-off and bypass lines to assure lasting drop-tight service. On steam returns, regrinding type Bronze Check Valves with 45° seats will remain tight even at extremely low pressures, to prevent opening and seepage from back flow.

SEVERAL TYPES AND PRESSURE RANGES of Jenkins Valves, other than those shown, can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

Copies of Layout No. 9, enlarged, with additional information, will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail the coupon.

VALVE RECOMMENDATIONS

Code	Quantity	Jenkins Valves	Service
A	5	Fig. 106-A Bronze Globe	H.P. Shut-off
B	4	Fig. 106-A Bronze Globe	L.P. Shut-off
C	2	Fig. 106-A Bronze Globe	Free Blow
D	2	Fig. 106-A Bronze Globe	Trap Test
E	2	Fig. 106-A Bronze Globe	Drip Shut-off
F	2	Fig. 106-A Bronze Globe	Manual By-Pass
G	2	Fig. 168 Angle w/Union	Radiator Shut-off
H	6	Fig. '92 Swing Check	Steam Return
I	1	Fig. 167 Globe w/Union	Radiator Shut-off

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To save time, to simplify planning, to get the advantage of Jenkins specialized valve-engineering experience,—select all the valves you need from the Jenkins line, fully described in the latest Jenkins catalog, No. 76. It's your best assurance of the *lowest cost in the long run.*

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Front Lines

IS MR. TRUMAN really president of the United States? This rather startling suggestion is discussed in detail in the February 1946 issue of the *Houghton Line*. Somebody wrote to the editor of the *Line* about it. The Constitution of the United States provides that when the president dies or is incapacitated, the duties and powers of the president shall "devolve" upon the vice-president. But the Constitution does not say that the vice-president shall *become* president. Why then is the oath of office as president administered to him? Well, there are reasons—but see the *Line* for the whole interesting story.

AN EXHIBIT of models of small houses was on display in our city. There were eight or ten of them, mostly of modern design, with flat roofs, designed to utilize all the latest house-building ideas we have been telling you about in Front Lines—the modern plastics, bonded plywood, modern heating and ventilating systems, the kitchens of tomorrow, and so on. A well-dressed, distinguished-looking middle-aged man and his equally distinguished-looking, fur-coated wife stood in silence for a long time before one of the long, low, flat-roofed models. Finally the woman, a quizzical gleam in her eye, asked, "Well, Charles, what do you think of it?" "Hah!" snorted Charles. "Looks to me like a tool shed left over from a big construction project!"

HOW AND WHERE to Collect Social Security is discussed in detail in a new 32-page bulletin. It is the first and in fact the only publication we have seen that explains in detail—AND IN ENGLISH, not lawyer-ese—what social security is all about. Everybody is aware that 1 per cent of his wages is collected for it. But how many know that his employer also pays into the fund at least as much and sometimes more for each individual? The booklet tells you in detail who is eligible for social security, how to calculate it, how to collect it. You may be surprised at the size of the stake you and your employer are building up for you, to use in your old age. Social security is distinctly NOT CHARITY. It is money you are putting into the "kitty"—merely another form of insurance. The booklet explaining all this is published by the Commodity Research Bureau, Inc. and we'll gladly send you a free copy of it on request.

FOR THOSE who want formal education in refrigerating engineering and air conditioning the recent Educational Guide to Refrigeration and Air Conditioning Training Facilities in the United States, compiled by the ASRE Committee on Education, tabulates the courses available in 167 schools. These include not only regular courses in both the undergraduate and graduate schools of colleges and universities, but also a large number of university extension courses, vocational and trade school courses and correspondence school courses.

EVER PUMP A FISH? Not pump out his interior but pump him and thousands of his fellow—and girl—fish out of a fishing boat's hold. That's the modern high-speed way of doing it—665,000 lb of 'em per hour in one installation. Simply install a specially-designed fish pump on the wharf, run the suction hose down into the vessel's hold, flood the latter and pump about 90 per cent fish without damage—it says here—and 10 per cent water. Does it sound like fish chowder or fish hash to you? Anyway, one man can do it all, thus destroying forever the artistic fish-unloading scene: dozens of men in hip boots, gleam of silver scales in the sun, pungent sea-clean smell of fresh fish. O-o-o-h! the p-o-o-r fish!

IF WE HAD SOME HAM, we could have some ham and eggs—if we had some eggs. That seems to be the situation, too, in the great program we were going to have in this country for building thousands of new modern homes after the war. The architects have designed these homes so that *if* they can be built by mass production and *if* that doesn't put the existing housing and real estate industry out of business and *if* the new materials are available, and *if* people want them and *if* the prefabricators can turn them out fast enough the public can have them—if-if-if-if. It seems that if we wanted them as much now as we did during the war to house war workers at Oak Ridge, we could get them by the same methods. Just how is a house prefabricated? Everybody has been using the word but just what do the prefabricators do? Nothing new about the process. It has been used since 1892 by a company near Boston. Their methods and materials are described in detail in the February issue of *The Resinous Reporter*.

DUTIES OF AN ENGINEER in the engineering department of a company manufacturing Diesel engines are described in detail in a recent publication. All men interested in entering the Diesel field—veterans, high school and college students and others—should know what these duties are, whether they want to go into production, sales or operation work. If you're interested, we'll have a copy sent to you upon request.

ILLEGITIMUS NON CARBORUNDUM. That's the inscription on a bronze plaque that has stood during most of the war on the desk of Dr. Vannevar Bush, director of the OSRD. When the Washington Award was conferred on Dr. Bush the other night (see What Leaders Say—page 53 this issue) one of the introductory speakers referred to this masterful example of pseudo-Latin and brought down the house with the translation. If your Latin is as nebulous as ours was when we first heard of that phrase, you may need a little help with it, which we'll gladly give you on request.

AN ASTROLOGICAL MURAL of the heavens in cerulean blue and gold leaf, duplicating the original design in tempera on the ceiling when it was new in 1913, decorates the new ceiling in the Grand Central Terminal in New York City. The new ceiling is built of 4-ft by 8-ft sheets of Flexboard ⅛-in. thick. The design of the Zodiac required 40,000 ft of ¾-in. wide gold leaf.

YOUNG MEN looking for the shortest path to employment as metallurgical engineers in the steel industry should burn academic oil especially on the fundamental sciences as preparation for postwar jobs, according to E. C. Wright, assistant to the president of National Tube Co., addressing the AIM & ME.

WITHOUT PHOTO-LOFTING, the United States would not have been able to build as many planes as it did and the war might still be going on. Photo-lofting is a process developed by the Glenn L. Martin Co. for photographing master plans or patterns directly on sheet metal or Masonite so that the material can be cut or shaped quickly and accurately without calculations or measuring. For airplane work, a huge 10-ton camera occupying two rooms was necessary but this was only because of the size of the pieces handled; for other and smaller industrial applications, the same simple principles would apply. Tool engineers say it is the most revolutionary single development in their craft in a generation.

RADIANT or panel heating systems have attracted wide attention during recent years and one estimate is that there are now over a thousand of these installed in U. S. buildings. In 1941 Professor F. W. Hutchinson of Purdue developed a rational method of calculation for radiant systems, involving the solution of seven simultaneous equations, a discouraging and unhappy procedure to a busy engineer. He has now derived a single equation, as repored before the 52nd Annual meeting of the ASH&VE, for the determination of the feasibility of using an assumed surface at an assumed temperature, making the calculations much more convenient.

WHAT MOTOR CARS COULD BE, with rear-engined cars, floor space enough for comfortable seating, couches and equipment for sleeping in the car at night, forced ventilation, easy control and steering, greater speed and comfort, was told in detail by William B. Stout, famous designer, before the recent SAE meeting in Detroit.

COMMERCIAL STANDARD for Industrial Mineral Wool Products, All Types—Testing and Reporting, CS131-46 is now a recorded standard of this industry, announces the National Bureau of Standards. Mimeographed copies are available without charge from the Division of Trade Standards, National Bureau of Standards, Washington 25, D. C. Note that this covers methods of testing the various materials and not the materials themselves or the methods of using them.

RED BALL EXPRESS, the miniature electric train bought for your boy next Christmas—how we love to maintain that stupendous lie, prone on our pot bellies on the floor "fixing" the train on Christmas afternoon—is likely to contain many components made of Bakelite. For many of these, Lionel Corp. has found that the Bakelite is better from the engineering and structural point of view, also in reproducing minute details for authentic appearance.

NEW TECHNIQUE for catching air-borne materials on gummed cellophane sheets, developed by Williamson and Mabuce of Union Electric Co., has been employed in a city-wide study of the fall of fly-ash in St. Louis, Mo. A study made last fall in limited areas indicated that 90 per cent of all air-borne materials were cinders, soot and substances other than fly ash. Tests have shown that none of these can possibly come from the utility's power plants in and near the city because of the pulverized coal firing and that because of the use of precipitators, those plants emit very little fly ash.

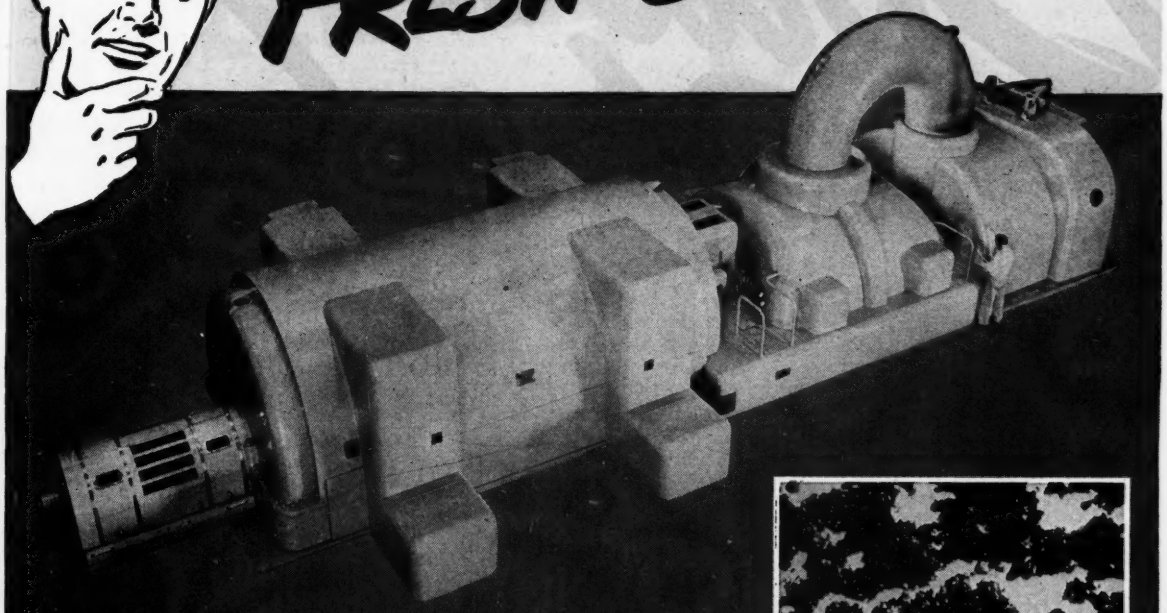
NEW TYPE OF HEAT EXCHANGER, developed for cooling or heating small amounts of liquids, is the Heliflow. In this, a spiral coil, manifold base plate and casing replace the tubes, tube sheets, headers and baffles of the conventional type. The unit is entirely counterflow, is designed for high temperatures high heat transfer, and the spiral coil expands and contracts, like a spring.

TO ANY ENGINEER who knows anything about power plants, cement plants and motion pictures, the doors of opportunity have been flung wide. He merely needs to go into any one of the towns of from 1000 to 3000 population in Ecuador and establish: (1) a power plant; (2) a movie theater; (3) a cement plant. So we learn from J. M. Sheppard's magazine *Exploration* sent to us from Quito. Here, if we ever saw one, is a concrete proposal. (O-o-o-o-o-o-h!! Heaven forgive us!)

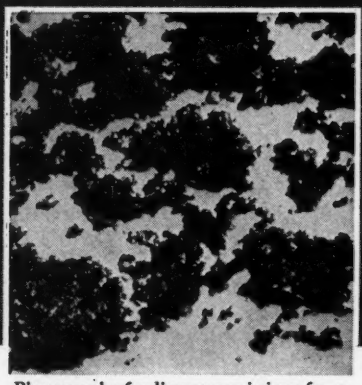
TO REDUCE pump packing troubles by providing a shaft seal with long life, a new seal on the market employs a sealing washer driven by the shaft against a stationary seat, the two lapped together and the entire assembly floated with a neoprene bellows, neoprene supports and a neoprene cushion for the seat, all designed to compensate for misalignment, wear, shaft vibration and end play.

IN CONNECTION with a comprehensive study of the properties of moist air, a co-operative project of the ASH&VE and the Towne Scientific School of the University of Pennsylvania, a critical study of standard steam tables by the authors indicated that those data were inaccurate in the range of temperatures below 212 F. John A. Goff and S. Gratch presented (before the ASH&VE) revised data believed to be more accurate than previous tables, on spectroscopic constants, enthalpy and entropy at zero pressure, enthalpy coefficients, and vapor pressure of ice.

TIME TO TAKE A FRESH START?



DON'T "INFECT" NEW TURBINE OIL BY PUTTING IT IN A DIRTY SYSTEM!



Photograph of sediment consisting of rust particles, chips of metal, carbon and gum removed from the lube oil system of a large steam turbine. Proper cleaning of a turbine's lube oil system before the initial charge of lubricating oil is installed can save serious trouble.

SHELL CLEANING PROCEDURE

makes it easy—makes it sure!

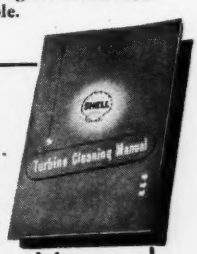
• A small amount of sludge and dirty oil acts on clean, new oil like a rampaging disease—can shorten its life 50 to 75%. Chemists call it the auto-catalytic effect—sludge, metal particles and rust acting as catalysts to hasten the oxidation of new oil.

Before you add that next batch of make-up oil to your system, be sure to get details about Shell's Turbo Cleaner and the Shell Cleaning Procedure. *You may decide to take a fresh start.*

Remember, too, this procedure should be followed before putting the first charge of oil in *new equipment.* As insurance, it's cheap enough to know that your turbine is free of contaminants such as slushing compound, run-in oil, and metal chips.

Call the Shell Lubrication Engineer, or write for your copy of the Turbine Cleaning Manual. Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California.

SEND FOR THIS BOOKLET NOW!



Every turbine owner and operator should have a copy. It contains full details on the Shell Turbo Cleaner and Shell Cleaning Procedure, and shows you how to get peak efficiency, lower operating costs.

SHELL

SHELL TURBO OIL

Double Check ON

Here's an instrument that brings boiler water level indication right down to eye level, on the instrument panel or other convenient location—a perfect *check* on hard-to-see overhead gages.

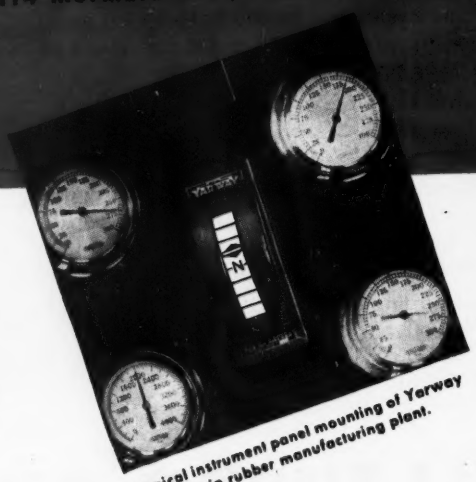
Yarway's Remote Liquid Level Indicator is always accurate because it is operated by the boiler water itself—by the pressure differential between a constant head of water and the varying head in the boiler drum. Action is instant, constant, frictionless. *There are no stuffing boxes.* Indicating mechanism is never under pressure . . . it is perfectly balanced on jewelled bearings outside of the pressure chamber.

From coast to coast the Yarway Indicator is meeting with enthusiastic approval. As one prominent user said, "If I couldn't get another one like it, I wouldn't sell the one I have for many times its cost!"

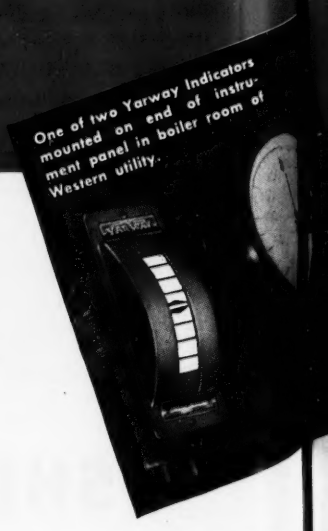
More than 2,500 have already been bought for indicating boiler water level, feed heater water level, and superheater pressure differential. For complete description of operating details, write for Bulletin WG-1821.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

Six Yarway Remote Liquid Level Indicators flush-mounted in boiler room of large Southern textile mill.



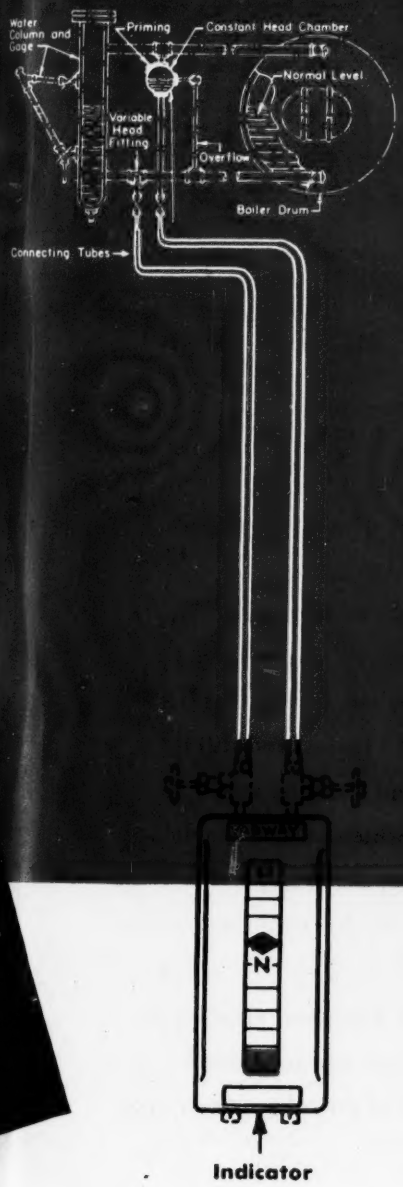
Typical instrument panel mounting of Yarway Indicator in rubber manufacturing plant.



One of two Yarway Indicators mounted on end of instrument panel in boiler room of Western utility.

YARWAY **REMOTE LIQUID**

BOILER WATER LEVELS



LEVEL INDICATOR

16 B&W VETERANS AT OAK RIDGE...

MANY of them could have been honorably discharged from active service years ago—yet the imperative speed and secrecy of the atom project brought 16 veteran B&W Boilers one of the most vital, historic tasks ever assigned to any boilers in all recorded time.

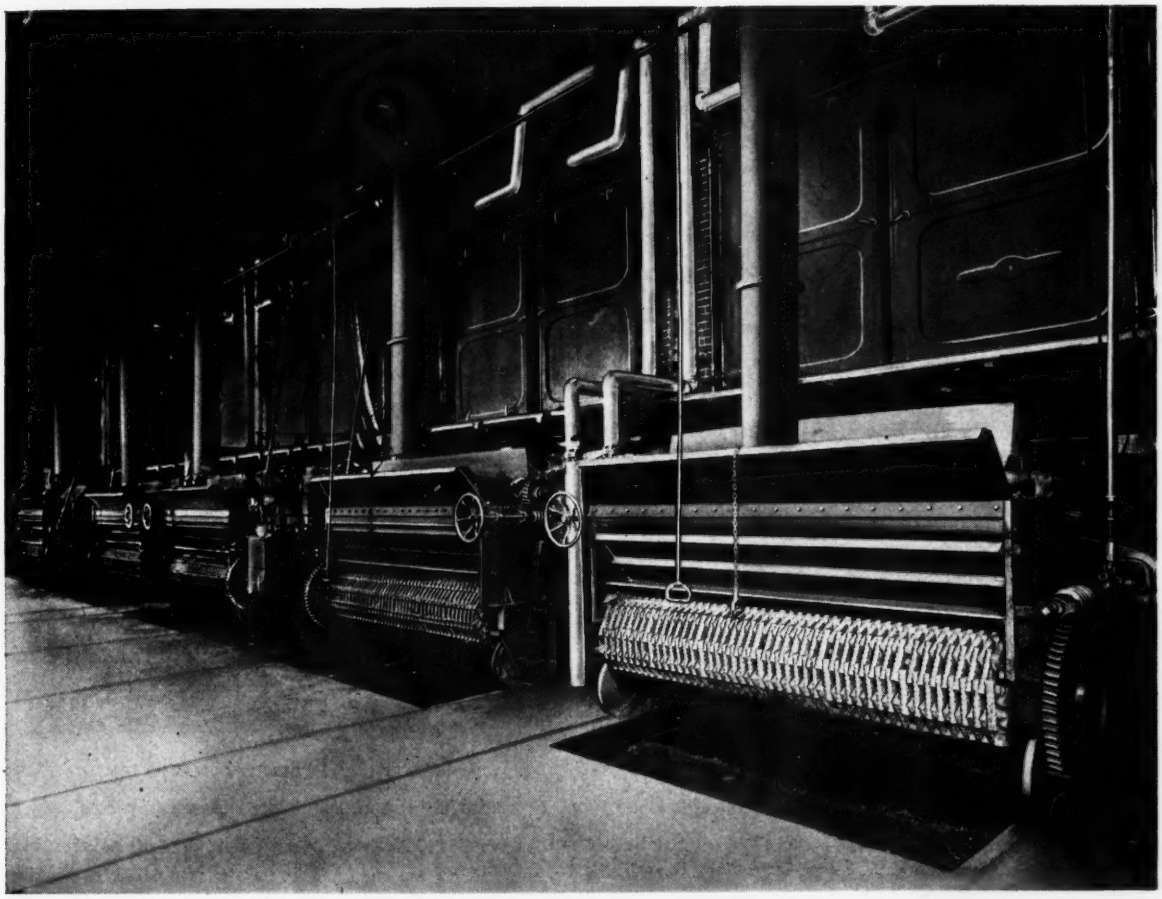
"Drafted" from sugar refineries, locomotive works, utility plants . . . from Massachusetts, Pennsylvania, New York, Kentucky, Louisiana . . . the 16 veteran B&W Boilers were reset at Oak Ridge to supply a large part of the total steam requirements for the Oak Ridge project.

In fulfilling this important assignment even after 25 to 40 years of continuous service elsewhere, these boilers are convincingly demonstrating the long useful life, lasting dependability, and operating satisfaction that B&W has been building into steam-generating units for over 60 years—and still is.

Important also to the success of this dismantling and resetting job were the long-preserved specifications of boiler details which were available from B&W records. With this information, necessary replacement parts were readily obtained to original equipment specifications, thus avoiding possible delay in getting the boilers into service.

Modern B&W boilers, too, can be relied upon for long-term satisfaction because they are the products of the same kind of sound engineering and construction that made possible the outstanding record of these 16 veteran units.

DRAFTED FOR SERVICE



Some of these B&W boilers—in service since 1904—were removed to Oak Ridge where they are giving additional years of satisfactory service.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

G-3217

THE C-E SPREADER

A stoker designed to— 1. burn a wide variety of coals—including the poorer grades. 2. operate efficiently and dependably. 3. handle load swings quickly and easily.

The C-E Spreader Stoker is a "natural" for the conditions that exist these days. As an old-time operator said recently, "The best coals – you can't get 'em, but if you could, you can't afford 'em." How right he is . . . and apparently no improvement in the situation is in sight.

What to do about it? Install a stoker that will handle satisfactorily the coals that are economically available in your present day markets – and that sounds like a specification for the C-E Spreader Stoker.

C-E Spreaders are delivering that kind of service all over the country – all over the world in fact – Canada, Alaska, South America, Russia, China – and that *really* means all kinds of coal.

As for efficiency – the following is a quotation from a recent report on an installation comprising three large C-E Sectional Header Boilers fired by C-E Spreader Stokers. "Over a period of years, the efficiency of all three boilers has exceeded the guaranteed efficiency by at least two points and the maintenance costs have been extremely low."

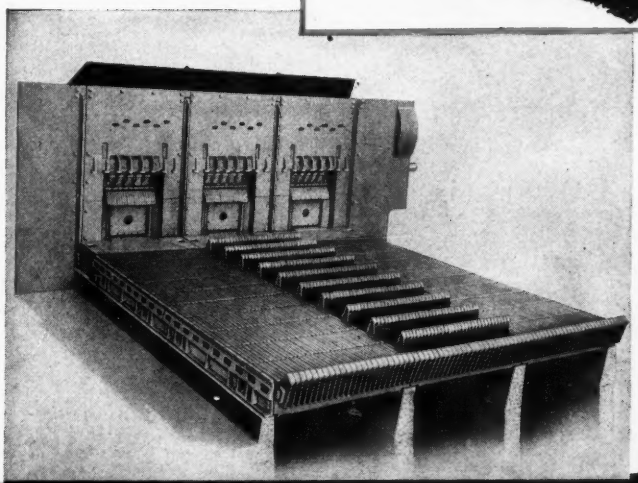
About load swings – during a recent test on a C-E Spreader-equipped C-E Steam Generator designed to deliver 115,000 lb of steam per hr at 230 psi, the rate of steam output was jumped from 60,000 to 128,000 lb per hr in 45 seconds. Steam pressure dropped only 5 lb and had returned to normal within 10 minutes.

So if freedom of choice in the coal market, operating efficiency, low maintenance and ability to handle load swings easily are important factors in your plant – the C-E Spreader is *your* stoker. A-955

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

R STOKER burns cheaper coals– EFFICIENTLY

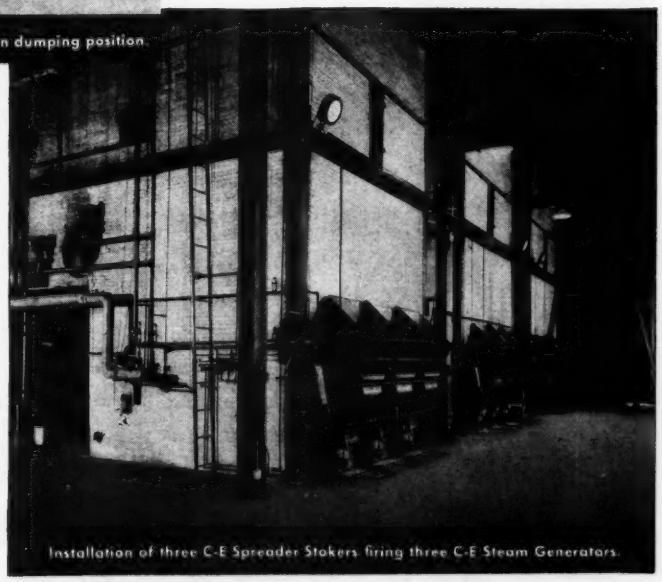


Rear view of C-E Spreader Stoker with one section of grates in dumping position

THE C-E SPREADER STOKER PAYS FOR ITSELF OVER AND OVER

In an average installation the cost of coal used in a year exceeds many times the initial cost of a C-E Spreader Stoker. Moreover, the first cost of the stoker is soon absorbed by its saving in coal cost – an economy cycle that is repeated throughout its many useful years.

Approximate application range of C-E Spreader Stoker – 150 boiler hp to largest units suitable for stoker firing. Simple, rugged construction. Hopper, feeding and distributing mechanism, variable-speed drive and motor are contained in a compact unit. Rotating spreader blades feed coal into furnace in crisscrossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on a grate – stationary or dumping type. Grate surface is zoned for regulating air admission and to facilitate cleaning. Adapted to limited space. Easy operation. Low maintenance.



Installation of three C-E Spreader Stokers firing three C-E Steam Generators.

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

TERRY

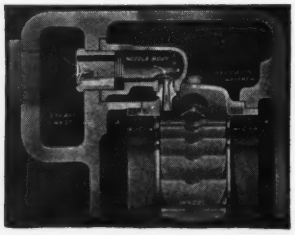
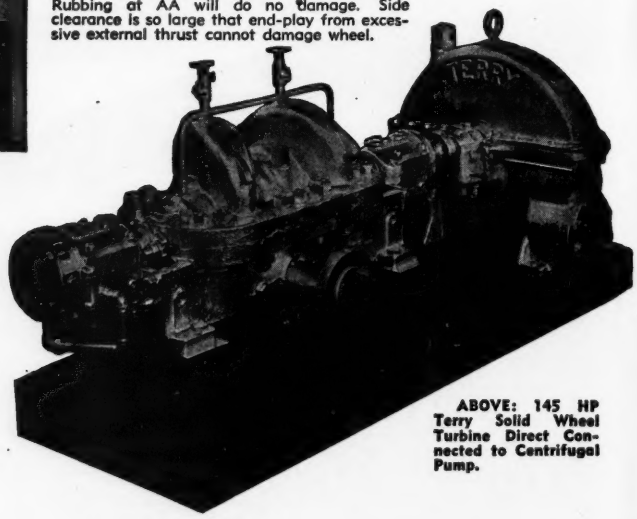


DIAGRAM SHOWING WHEEL CLEARANCES.

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



ABOVE: 145 HP Terry Solid Wheel Turbine Direct Connected to Centrifugal Pump.

THESE LARGE WHEEL CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

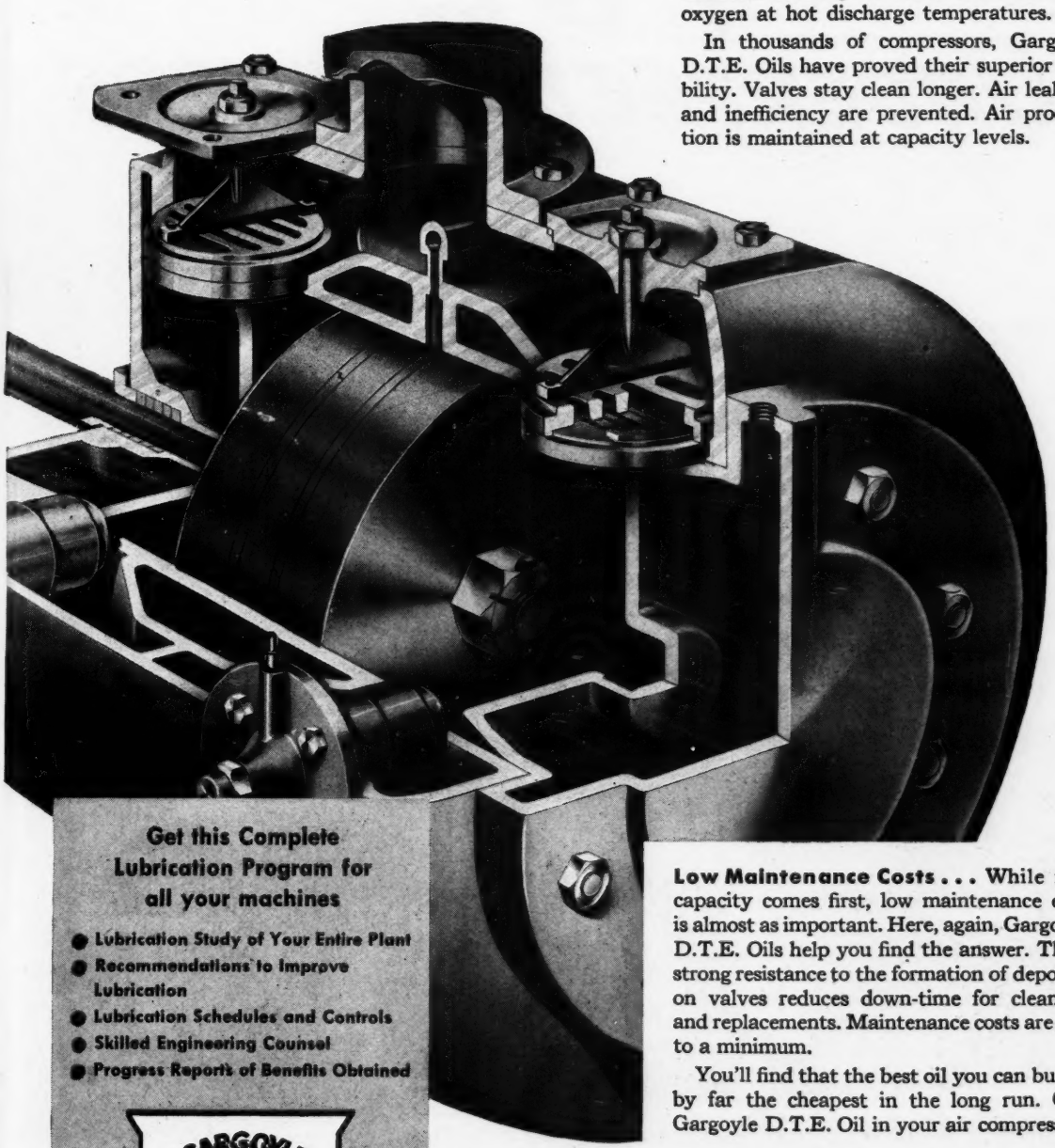
T-1158

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

What do you expect from your Compressor?

Continuous Full Power . . . For maximum efficiency, your air compressor valves must stay free from clogging oxidation deposits. This calls for a compressor oil with high chemical stability to resist the attacks of oxygen at hot discharge temperatures.

In thousands of compressors, Gargoyle D.T.E. Oils have proved their superior stability. Valves stay clean longer. Air leakage and inefficiency are prevented. Air production is maintained at capacity levels.



Low Maintenance Costs . . . While full capacity comes first, low maintenance cost is almost as important. Here, again, Gargoyle D.T.E. Oils help you find the answer. Their strong resistance to the formation of deposits on valves reduces down-time for cleaning and replacements. Maintenance costs are cut to a minimum.

You'll find that the best oil you can buy is by far the cheapest in the long run. Get Gargoyle D.T.E. Oil in your air compressor.

Get this Complete Lubrication Program for all your machines

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

Socony-Vacuum Oil Company, Inc.

and Affiliates: Magnolia Petroleum Co., General Petroleum Corp. of Calif.

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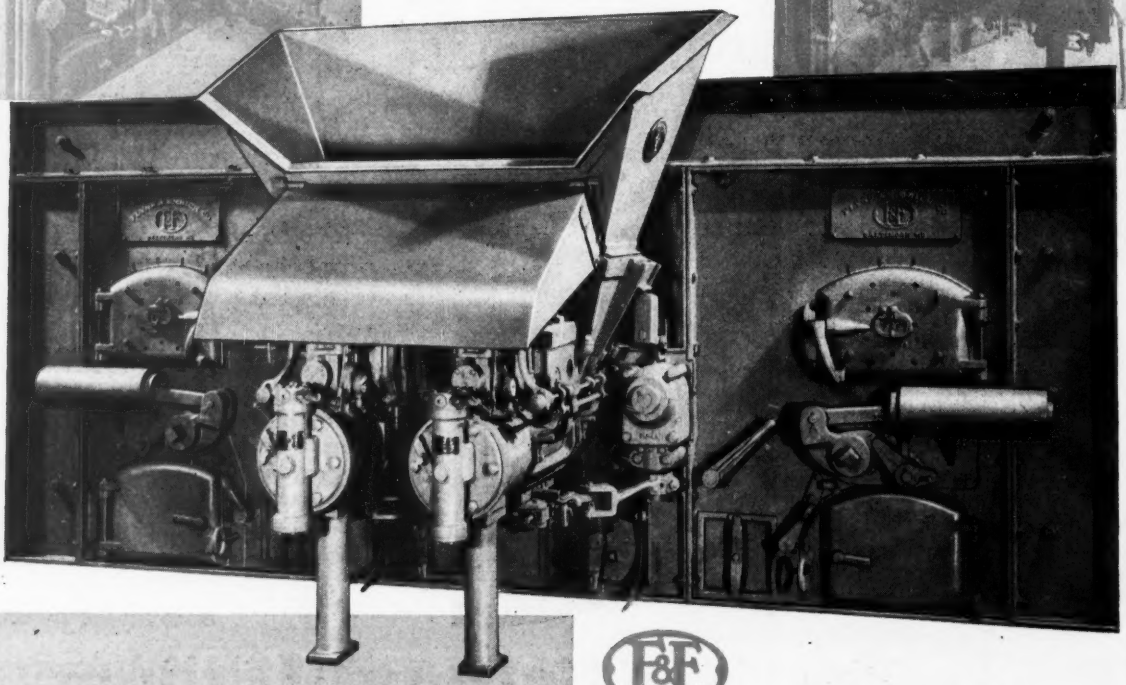
SERVING OVER 700,000
BOILER HORSEPOWER

"F & E"
UNDERFEED STOKERS

There is an "F & E" Underfeed Stoker to meet your requirements—whether they be 1000 lbs. of steam per hour or 40,000!

See the "F & E" representative in your locality, your own consulting engineer or write manufacturer for information that tells WHY and HOW "F & E" Underfeed Stokers increase output of boilers, reduce fuel bills, provide dependable operation, increase efficiency.

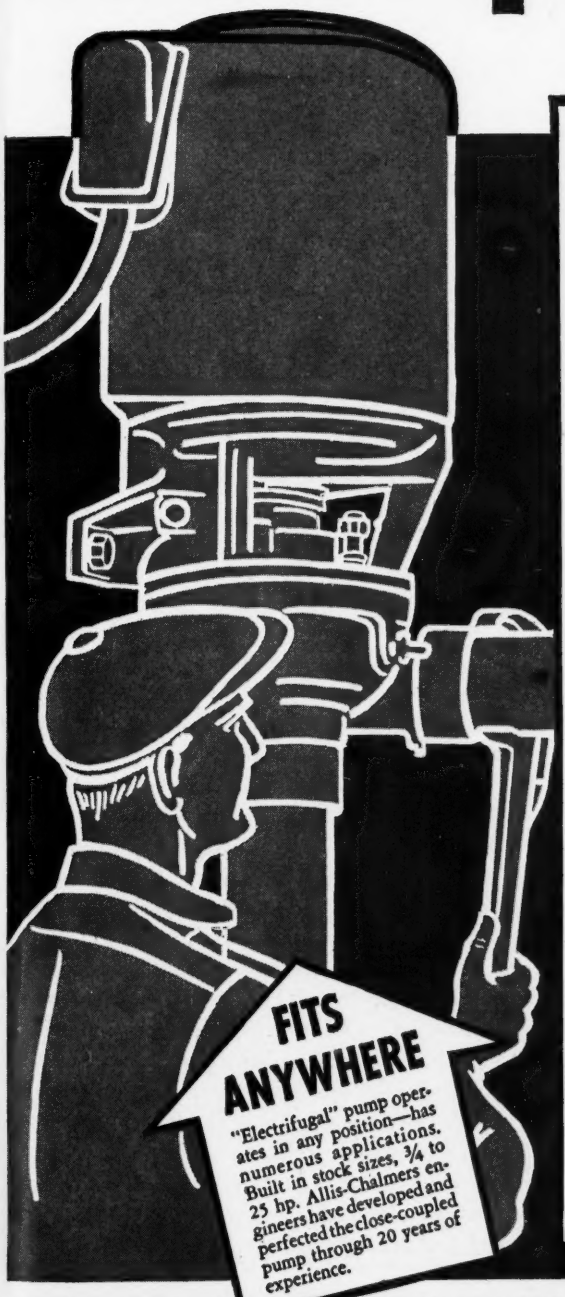


THE ONLY STOKER
WITH THIS COMBINATION OF ENGINEERED FEATURES
1-Choice of Electro-Hydraulic or Steam Ram Drive; 2-Internal Timer Governor; 3-Sliding Bottom Retort; 4-Renewable Ram Case Liner; 5-Exterior Fuel Bed Adjuster; 6-High Efficiency Tuyeres

F&E

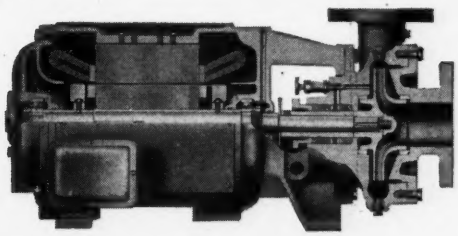
FLYNN & EMRICH CO.
Established 1842
HOLLIDAY & SARATOGA STREETS, BALTIMORE 2, MARYLAND
Representatives in Principal Cities

Hook Up...AND Pump!



FITS ANYWHERE

"Electrifugal" pump operates in any position—has numerous applications. Built in stock sizes, 3/4 to 25 hp. Allis-Chalmers engineers have developed and perfected the close-coupled pump through 20 years of experience.



A-C "Electrifugal" Pump Cuts Installation Time

This compact "Package" pump comes fully assembled. No coupling to line up. Just bolt it down, make pipe and power connections — prime and pump! More than that, this pump costs you *less to buy — less to operate.* Read these interesting facts:

SIMPLE, COMPACT DESIGN

Motor and pump are built into one rigid frame, with rotor and pump runner on a single shaft. Result: one third less space — fewer parts — *lower cost.*

EASY TO SERVICE

Packings, rotor, impeller, and all moving parts are easy to get at. Quickly taken apart, checked, and reassembled. Down time is reduced to a minimum.

LOW MAINTENANCE

Ample bronze wearing rings, bronze water seal and valve — shaft sleeve and deflector — five packing rings — precision workmanship — and other quality features all add up to longer life, less maintenance cost.

UNDIVIDED RESPONSIBILITY

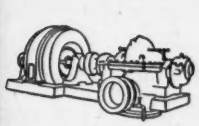
Allis-Chalmers builds both pumps and motors — backs them up with unsurpassed experience and reputation in both fields. Call your A-C office for help on any pumping problem . . . or write for bulletin B6059. ALLIS-CHALMERS, Milwaukee 1, Wisconsin.

HEAR THE BOSTON SYMPHONY

Every Saturday Evening, American Broadcasting Co.

ALLIS (AC) CHALMERS

Electrifugal **PUMPS**



COMPLETE LINE

of centrifugal pumps and motors. Single or double suction—single- and multi-stage—capacities to 170,000 gpm.

A 2010

THE TEST TUBE POINTED TO A WORN REGULATOR

The first sign of trouble in an important industrial plant was the failure of a superheater tube. Analysis of the scale in this tube made it evident that carry over of boiler water was taking place. Hall engineers, plant personnel and the boiler manufacturer cooperated in locating and eliminating all possible causes of carry over, and the condition was quickly corrected.

Nevertheless the turbine strainer accumulated deposit which made cleaning necessary as frequently as once a week, and eventually the steam line became clogged with deposit.

Unless data on steam quality were misleading, carry over was stopped—but the deposits were there.

The Hall field engineer came to his home office, where the staff explored the whole situation. The key to the problem, they decided, was the composition of the deposit. When carry over was taking place, silica content had been high. Now, in the last deposit tested, sodium sulphite and sulphate made up more than 90% of the deposit.

There could be only one answer. Boiler feedwater, to which sodium sulphite was being added, must somehow be getting into the steam line. Such leakage could take place at only one point, they decided, and that was at the feed pump excess pressure regulator.

The Hall field engineer returned to the plant and, with the power house engineer, checked the regulator. They found that the sodium sulphite chemical feed line was connected into the feedwater control line to the regulator, which was of the old piston type. Water containing the chemical was leaking past the piston, through the steam control line and into the steam line.

The plant lost no time in connecting the sodium sulphite chemical feed line directly into the main boiler feed line, and in ordering a new diaphragm type excess pressure regulator. These changes ended the trouble, and removed a probable source of serious interruptions in service.

When procedures set up by Hall Laboratories are carefully followed, boiler water troubles come close to the vanishing point. When trouble does occur—usually, as in this instance, because of some unusual quirk in the boiler room equipment—Hall engineers trace that trouble to its source and show how to correct it.

Every plant that generates its own steam can profitably use Hall Service. We will be glad to send you full information.

HALL LABORATORIES, INC. • HAGAN BUILDING • PITTSBURGH 30, PA.

(A subsidiary of Hagan Corporation)

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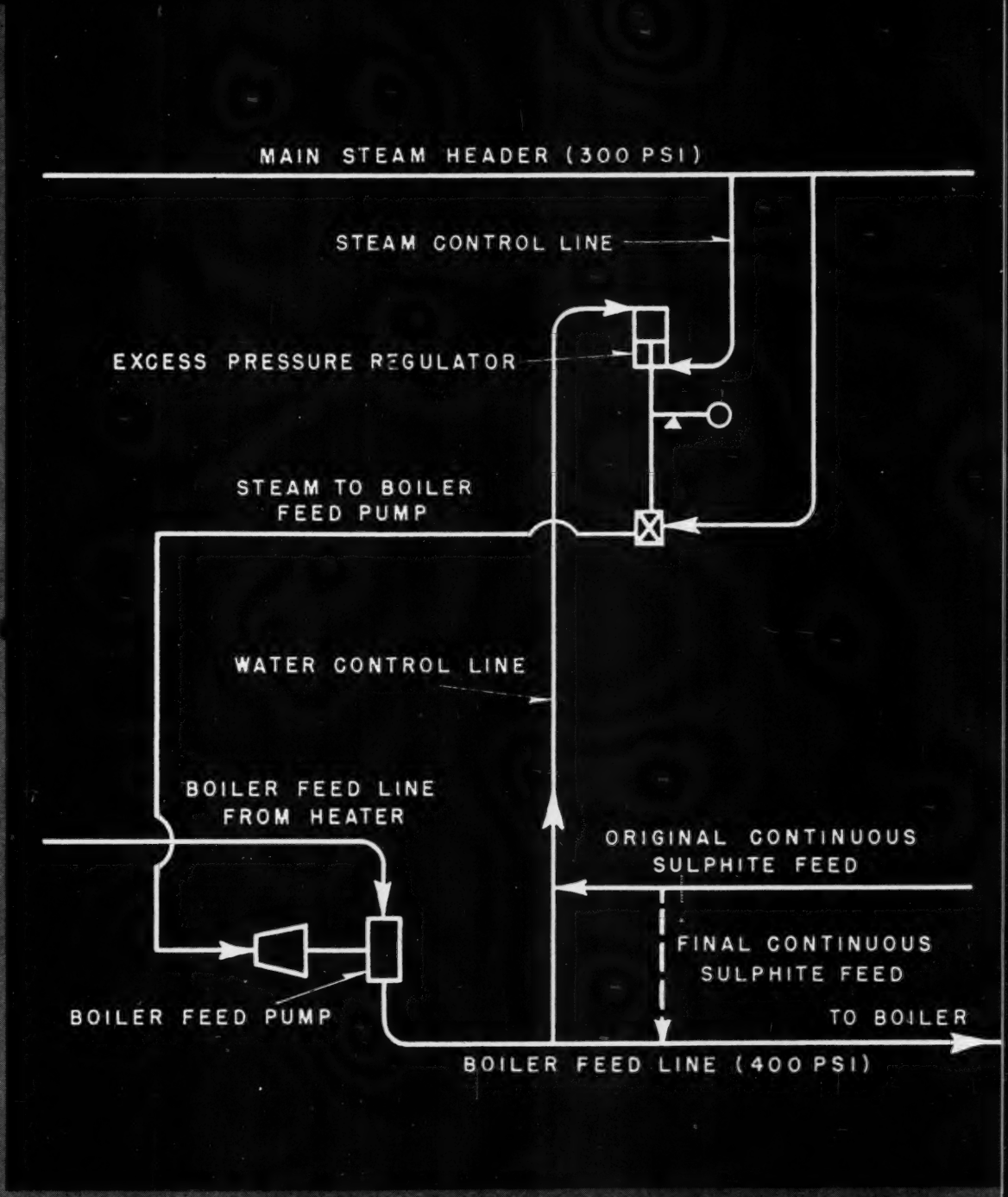
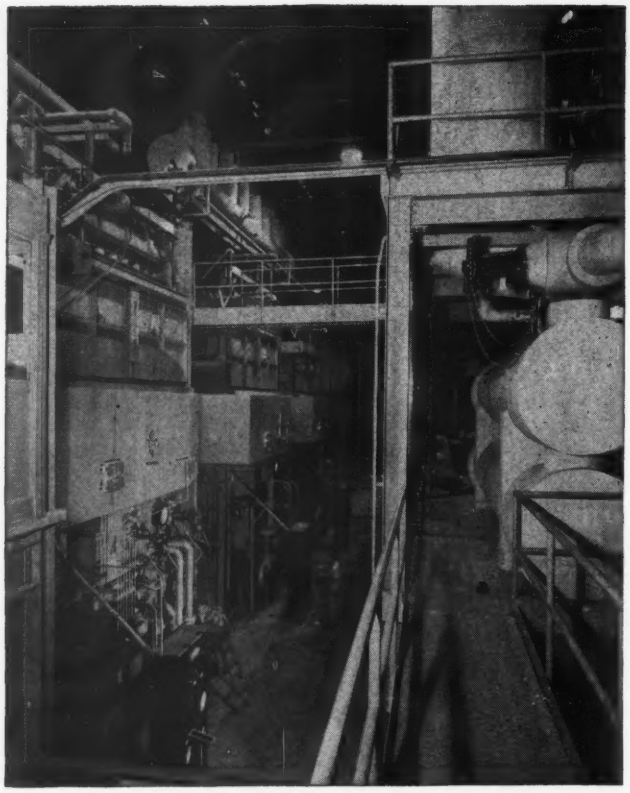


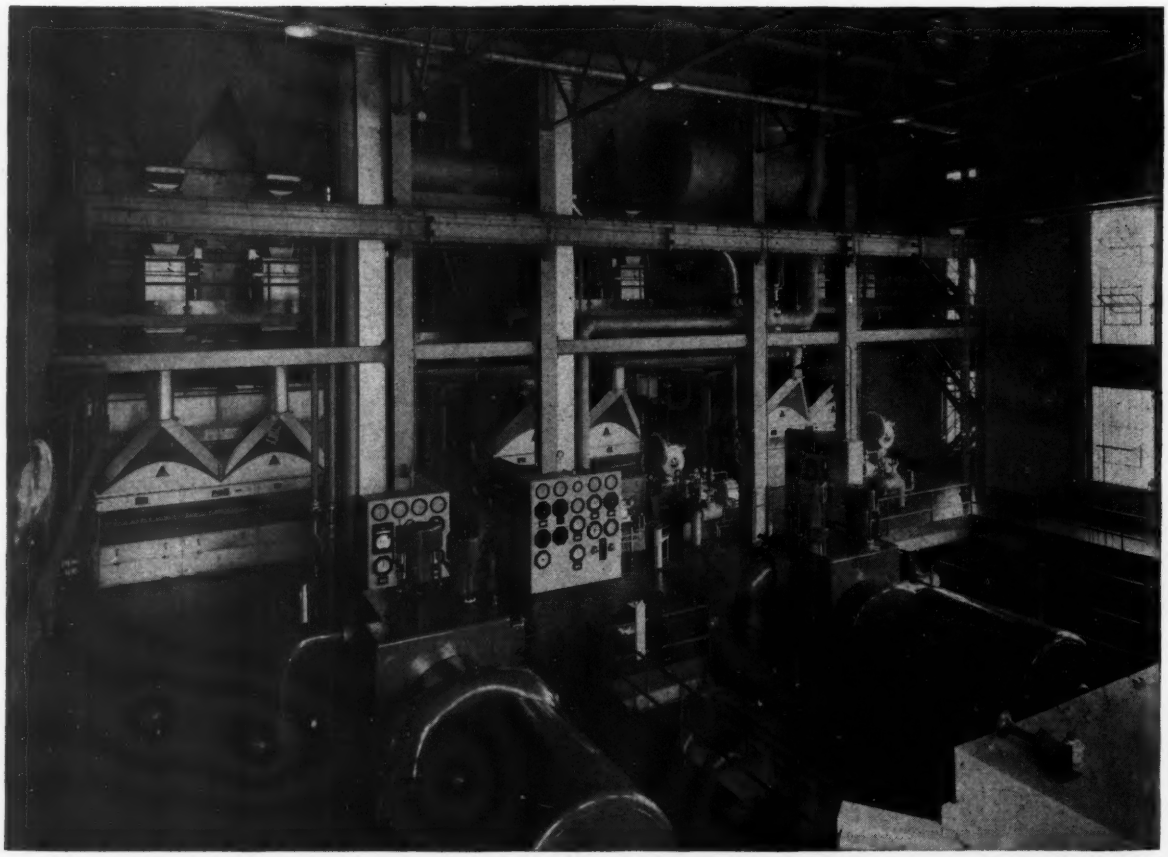
HALL SYSTEM *of Boiler Water Conditioning*



IT TAKES

Left:
Interior view of a new 400,000 lb. steam generating plant suppling steam for a modern industrial plant. Steam is generated in three gas fired boilers which are operated by a Republic automatic combustion control system.

Below:
A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.0 percent more building space, generated 114.3 percent more electric power but consumed 9.86 percent less fuel.



MORE THAN A GOOD BOILER TO CUT STEAM COSTS!

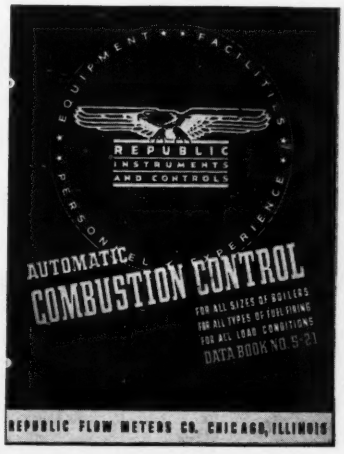
Low Steam Cost Is Not The Result Of Efficient Boiler Design Alone! It Is Determined By The Degree With Which Your Method Of Boiler Control Takes Full Advantage Of Those Economies Which Have Been "Built In" The Boiler And Its Auxiliaries.

To realize all the financial and operating advantages of modern boilers, they must be closely controlled. They have comparatively small water storage spaces and high combustion rates, hence under some conditions may be very sensitive to load fluctuations. In operating them, therefore, a number of repetitive adjustments must be made frequently and practically simultaneously on several units of auxiliary equipment in order to maintain highest boiler efficiency. The difficulty of making the required repetitive adjustments accurately and synchronously by hand at the individual auxiliaries is obvious.

What is needed, therefore, is a method for making and co-ordinating these adjustments automatically from a centralized control point, at the same time permitting the operator to assume manual control at this point whenever necessary or desirable.

The REPUBLIC combustion control is a unified system controlling simultaneously, in measured quantities and in fixed (adjustable) proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

REPUBLIC combustion control systems are designed and built for all sizes of boilers—all types of fuel firing equipment—all load conditions. They fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of every-day operating requirements.



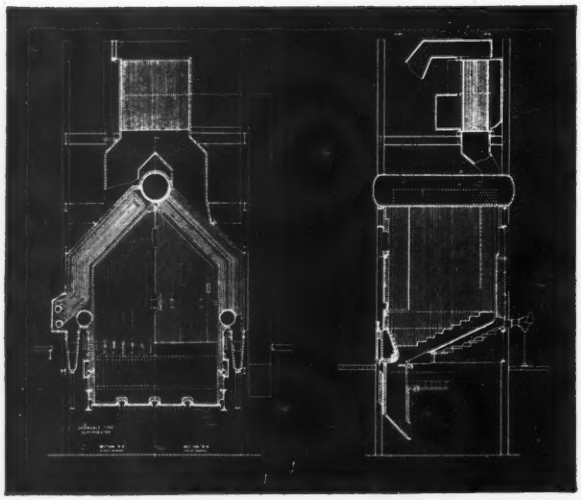
This 94 page data book on automatic combustion control is filled with usable information generally difficult to locate. If you are interested in the advantages of automatic combustion control, write for Data Book No. S-21.

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PKWY. CHICAGO 47, ILL.

S-A Steam Generators
FOR SMALLER CENTRAL STATIONS, MANUFACTURING AND INDUSTRIAL PLANTS

The S-A steam generator has been developed over a period of years to meet the requirements of smaller central stations, manufacturers, and industrial plants. Desirable operating characteristics of large central station units are approached in this small, compact, and highly efficient unit. The five installations shown here illustrate adaptability to varying conditions.



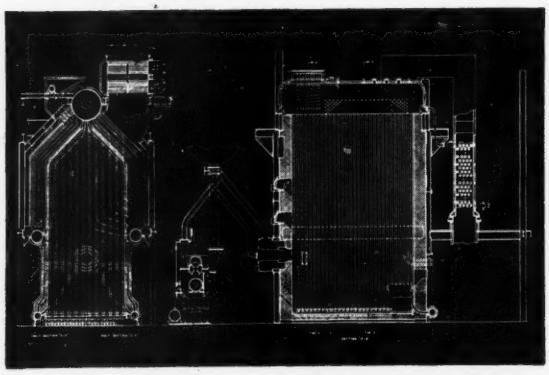
ELECTRIC MANUFACTURER

Number of Units.....1
Steam Capacity.....150,000 lb. per hr.
Design Pressure.....700 lb. per sq. in.
Operating Pressure.....650 lb. per sq. in.
Final Steam Temperature.....850 deg. F.
Feedwater Temperature .....350 deg. F.
Fuel.....Bituminous Coal
Efficiency (with air heater)....84.2 per cent

EASTERN MANUFACTURER

Number of Units.....2
Steam Capacity.....32,000 lb. per hr.
Design Pressure .....300 lb. per sq. in.
Operating Pressure.....250 lb. per sq. in.
Final Steam Temperature.....471 deg. F.
Feedwater Temperature .....220 deg. F.
Fuel.....Pulverized Coal
Efficiency (with economizer).....84.4 per cent

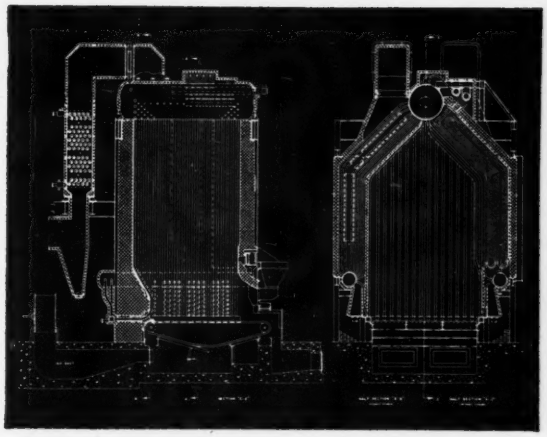
This unit includes a controlled primary air heater to supply the pulverizers with preheated air.

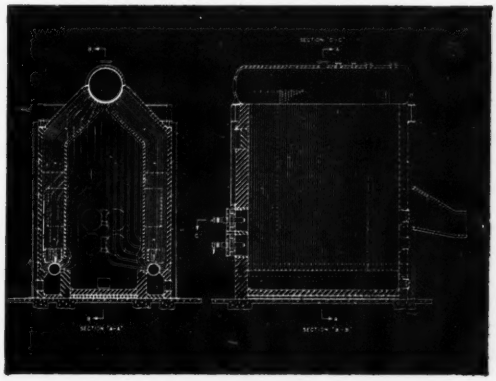


FW FOSTER

UNIT POWER PLANTS

Number of Units.....34
Steam Capacity.....38,000 lb. per hr.
Design Pressure .....475 lb. per sq. in.
Operating Pressure.....425 lb. per sq. in.
Final Steam Temperature.....740 deg. F.
Feedwater Temperature.....212 deg. F.
Fuel .....Bituminous Coal
Efficiency (with economizer).....80.6 per cent



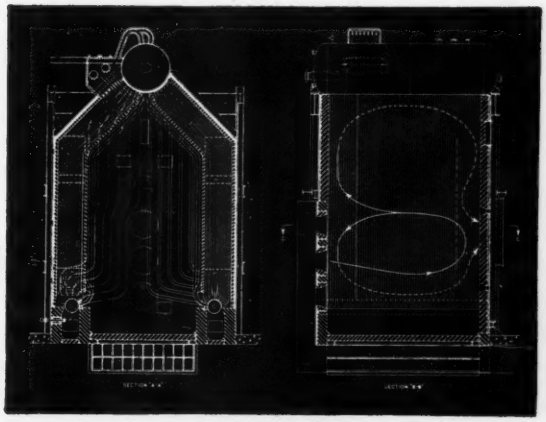


SOUTHWEST REFINERY

Number of Units.....5
Steam Capacity .....70,000 lb. per hr.
Design Pressure .....645 lb. per sq. in.
Pressure: Superheater Outlet.....250 lb. per sq. in.
Final Steam Temperature.....(Saturated)
Feedwater Temperature.....225 deg. F.
Fuel.....Refinery Gas
Efficiency.....79.1 per cent

FAR WEST REFINERY

Number of Units 2
Steam Capacity.....125,000 lb. per hr.
Design Pressure.....500 lb. per sq. in.
Pressure: Superheater Outlet...450 lb. per sq. in.
Final Steam Temperature.....560 deg. F.
Feedwater Temperature .....220 deg. F.
Fuel.....Oil and Gas
Efficiency (oil fired with air heater)..85.0 per cent



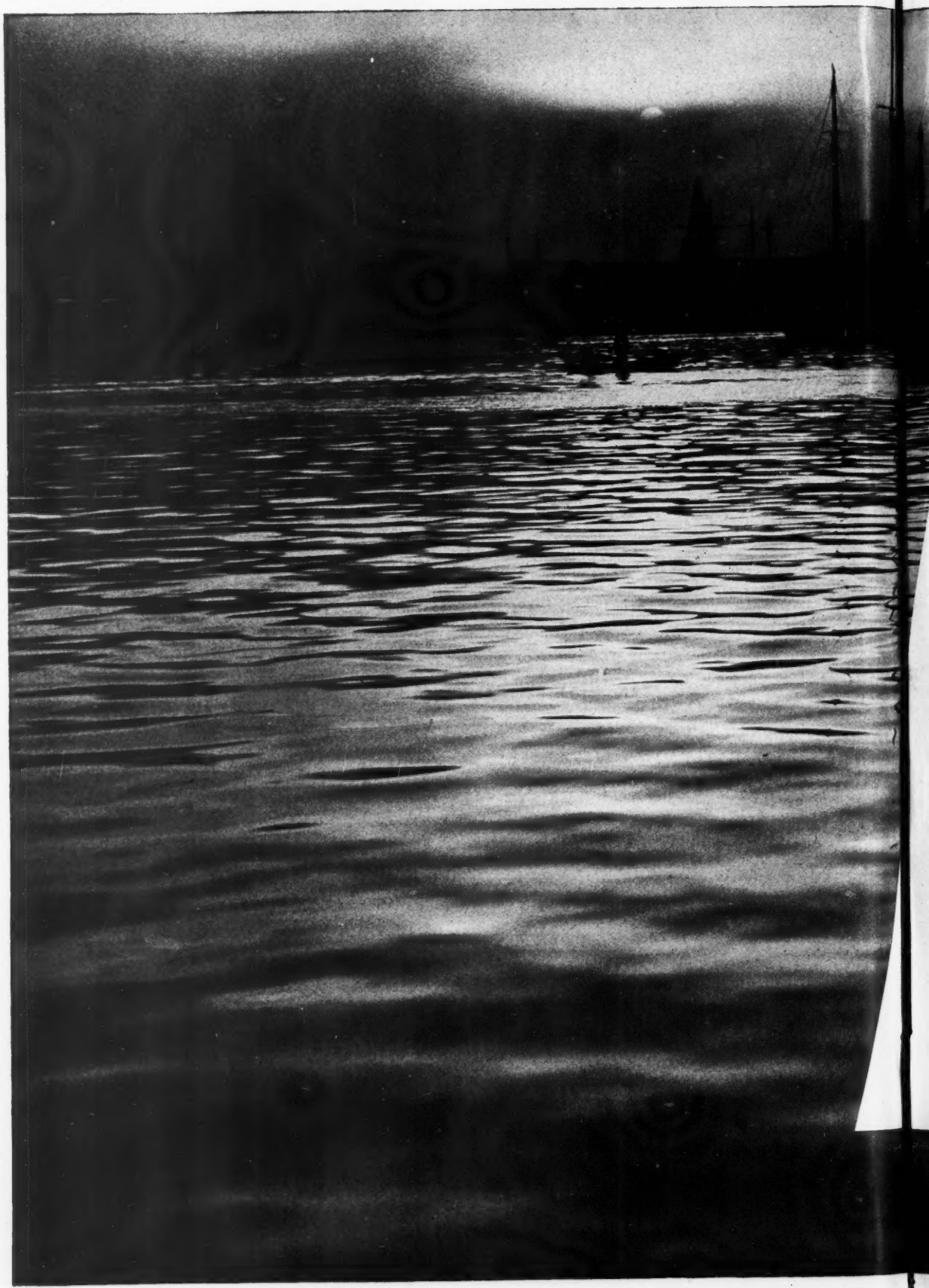
The detailed story of the S-A boiler—

◀ ***ASK FOR BULLETIN B-44-5***

FOSTER WHEELER CORPORATION

165 Broadway, New York 6, N. Y.

WHEELER FW



Improve Your *Boiler Water Conditioning* with a complete engineering service

• A highly competitive post-war market demands utmost efficiency in all manufacturing operations, including the generation of steam. Boiler outages must be kept to the irreducible minimum—fuel consumption must be kept down wherever possible and maintenance costs must be low. None of these conditions can be achieved without the benefit of an up-to-date water conditioning service—a service that is complete in all respects.

The boiler water conditioning service offered by W. H. & L D. Betz is preceded by an exhaustive initial investigation of every possible source of trouble. Then, based on our findings, we make detailed recommendations for chemical treatment and control. Daily tests are conducted by plant operators to determine the proper feed of chemical correctives. Supplementing these tests, periodic inspections are made by Betz Engineers who forward water samples to our laboratories for check analyses. As required, recommendations are promptly made for changes or refinement in control procedures.

Betz boiler water conditioning service is as complete and individualized as any such service can be. Over twenty years of research and practice as water specialists have made it so. Our Engineers will welcome the opportunity of discussing our service with you.

***Send for free illustrated booklet** giving a complete explanation of continuous boiler blowdown —what it is—how it operates—how to determine whether or not you need it—how much it costs. Ask for Bulletin 93-B. W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa.*

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING
INDUSTRIAL WASTE TREATMENT

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.

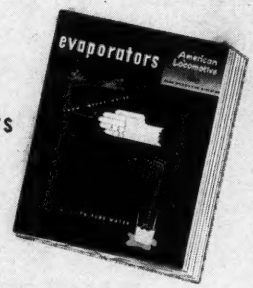
Again ALCO Steps Up Its Service to Power Plants

SPECIALIZING in thermal engineering, ALCO is closely concerned with power plant needs. Today, as prevailing steam pressures and production rates rise higher and higher, boiler scale problems become more acute.

Now ALCO steps up its service to modern power plants with still better ALCO Evaporators to meet this need. These improved ALCO Evaporators produce water vapor of higher purity than ever, and in greater volume per pound of steam. While thus eliminating boiler scale, they are so designed as to greatly simplify the problem of coping with removal and disposal of evaporator scale.

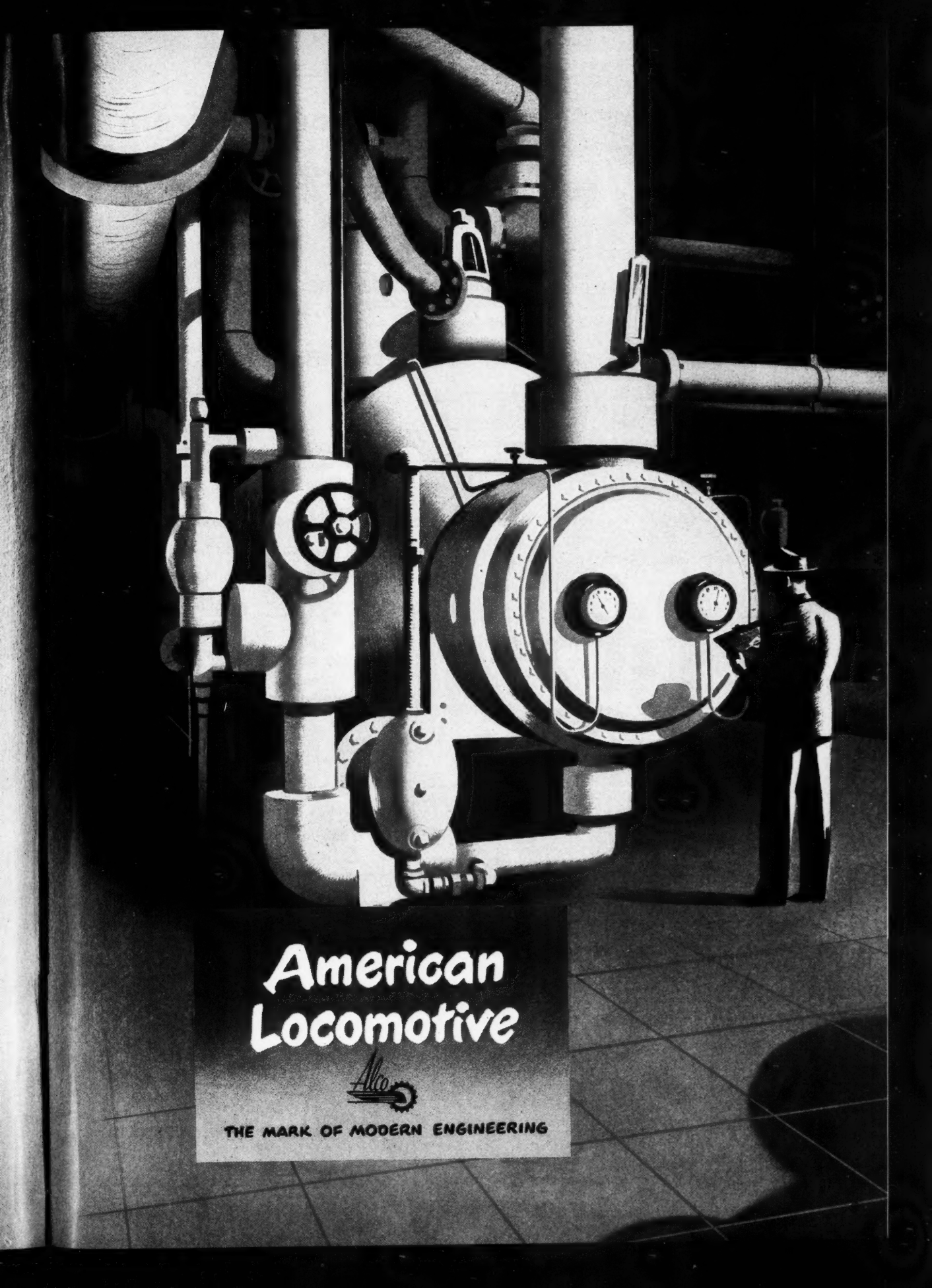
This equipment is a product of the same ALCO engineering skill, and knowledge of practical power plant requirements, that have made ALCO Feedwater Heaters widely preferred for efficiency, simplicity, and availability. Interesting details, describing and illustrating ALCO Evaporators, are in a new ALCO bulletin, *"Making Pure Water Plentiful!"* A copy will be sent you promptly on request. Write for it now.

NEW ALCO DEVELOPMENTS SOLVE BOILER SCALE PROBLEM. WRITE FOR DESCRIPTIVE BULLETIN



ALCO PRODUCTS FOR POWER PLANTS

Evaporators • Closed Type Feedwater Heaters • Evaporator Condensers • Diesel Engines, Stationary and Marine • Diesel Waste Heat Boilers • Jacket Water Coolers • Lubricating Oil Coolers • Fuel Oil Heaters • Oil Tank Suction Heaters • Condensers • Generator Air Coolers • Condensate Coolers • Prefabricated Piping • Blowdown Exchangers.


American
Locomotive
Alco
THE MARK OF MODERN ENGINEERING

Here are the benefits you get from

BAILEY CONTROLS

1. Fuel Conservation without decrease in output.

2. Lower Cost Steam.

3. Increased Safety for Plant and Personnel.

4. Better Power Service.

Bailey Controls for boilers make the important factors of steam plant operation work together to insure ideal performance.

In order that all of these factors may be regulated in harmony with each other and the load demand, Bailey Controls are carefully engineered to the requirements of the units which they serve.

Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Bailey field engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has extensive experience at his command, which includes tests on thousands of boiler installations, covering a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you secure the many benefits resulting from intelligent use of correctly selected and properly applied boiler control.

Bailey Controls for boiler operation are described in Bulletin 15-C. Write for your copy to Bailey Meter Company, 1040 Ivanhoe Road, Cleveland 10, Ohio —in Canada to Bailey Meter Company Limited, Montreal.

FUEL CONVERSION

If it becomes desirable or necessary to convert to another fuel, Bailey Controls can be adjusted easily to insure optimum results from the new fuel.

G-26

BAILEY METER COMPANY

1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO

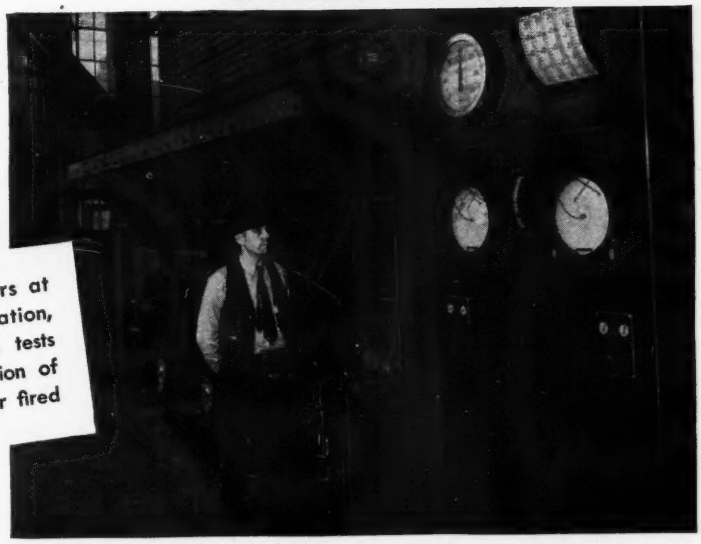
Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

APPLICATION to STOKER FIRED BOILERS

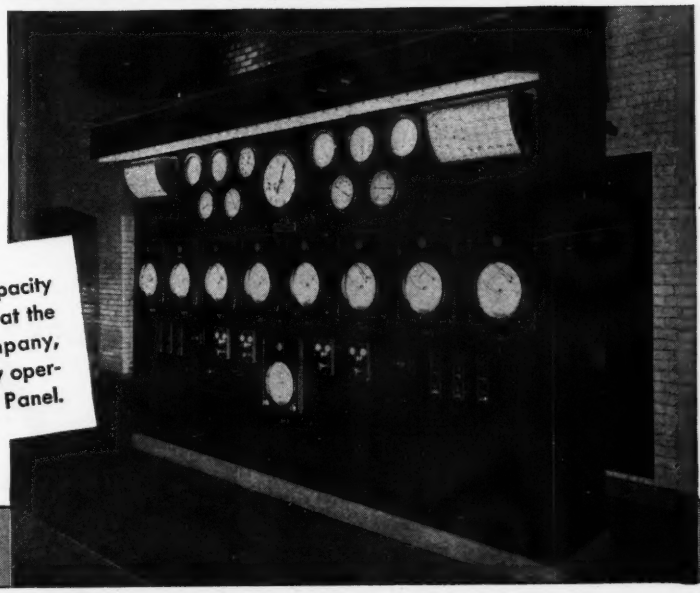
UNDERFEED

This Bailey Control Panel insures optimum performance from three underfeed stokers on two 25,000 and one 40,000 lb. per hour capacity boilers at Parker Appliance Company, Cleveland, Ohio.



SPREADER

Bailey Controls help operators at Graham-Paige Motors Corporation, Detroit, Michigan, to maintain tests standards in everyday operation of this 60,000 lb. per hour boiler fired by a spreader type stoker.



CHAIN GRATE

Two 40,000 lb. per hour capacity chain grate stoker fired boilers at the United States Tobacco Company, Chicago, Illinois, are efficiently operated by this Bailey Control Panel.

OUT of a few major forms of slime and algae come variations that make most of them as individually different as fingerprints. And the fingerprint slimes and algae react in a multitude of ways toward control treatments . . . One tough slime grew and thrived on a treatment compound that was quick death to closely similar forms! Nalco research found the proper treatment for that slime; and the Nalco Laboratories are available today to solve your particular slime or algae control problem. For year around freedom from water treatment headaches, call your Nalco Representative, or write direct.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place, Chicago 38, Illinois

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Nalco

THE SCIENTIFIC WATER TREATMENT FOR ALL INDUSTRY

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER, FUELS

1 **Water Tube Boilers**—Details and operating characteristics of these boilers are dealt with in this compact catalog. Illustrations are of the blueprint type and they clearly show the construction of the units. Installations and progress photos, taken during erection of the boilers, add to the usefulness and clarity of the publication. Design data and setting dimensions are given. The Bigelow Company.

2 **Refractory Lagging**—The excellent insulating properties of this material, for use on high and low temperature equipment, are described in this bulletin No. 327-G. The wide application of the lagging is emphasized by photos of typical uses. Each use is described briefly. Full page charts show method of determining required thickness of material and the efficiencies at these thicknesses. Quigley Company, Inc.

3 **Spreader Stoker Firing**—This bulletin No. 7 brings a careful analysis of the factors involved in the selection of spreader stoker equipment. Also included are copies of design drawings of spreader stokers adapted to various sizes and types of boilers. Fairmont Coal Bureau.

4 **Heat Generators**—This bulletin is crammed with specifications and dimensional information on heat generators. Two pages are devoted to material of this type and the remainder of the folder describes the features of the unit and the equipment. York-Shipley, Inc.

5 **Integral Furnace Boiler**—Bulletin G-17A gives data on integral furnace boiler, either stoker firing or oil burning. Can be converted to burn whichever is the more economical fuel. The Babcock & Wilcox Co.

6 **Boilermaking**—A fiftieth anniversary number has been issued by this manufacturer in its latest publication. The booklet is filled with scenes of the company's early days and many photos of present-day activities are given. The history of the concern is sketched. John Nooter Boiler Works.

7 **Coal Treatment**—A concentrated chemical compound for treatment of coal stock piles is described in a new bulletin. Departments of the folder give stock piling recommendations, drainage, method of application, spray equipment, recommended usage and many others. Illustrations increase the effectiveness of the bulletin. The Johnson-March Corporation.

8 **Heating, Cooling**—This buletin covers the field from winter air conditioners to commercial refrigeration and central system cooling equipment. Capacities and dimensions with keyed dimensional drawings are given. The bulletin is well illustrated. Airtemp Division, Chrysler Corporation.

9 **Steam Generators**—A booklet, No. S-6, describes the manufacturer's steam generators. The book shows how the generator develops steam of full working pressure within 5 minutes from a cold start. The unit's automatic operation is described and many of its characteristics are shown. Clayton Manufacturing Co.

10 **Spreader Stokers**—Bulletin No. 78 describes the Fyr-Feeder multiple spreader type stoker under the theme "burns coal like oil." The principle of the multiple spreader stoker is included with detailed illustrations and installation data. American Coal Burner Co.

ELECTRICAL

11 **Motor Selection Guide**—Briefly, these are the data presented in this useful book: motor characteristics; construction; applications; engineering data; list prices; dimensions; motor control; gearmotors; and where to buy. The book has been carefully put together to give the utmost speed in use consistent with the problem of doing a complete and comprehensive job. Allis-Chalmers.

12 **Fluorescent Lighting**—Handbook number one in a series of know-how lighting booklets deals with the Fluorescent lamp—what it is and how it operates. Contains many helpful diagrams and equipment photos. Westinghouse Electric Corp.

13 **Formulas for Electrical Engineers**—An 8 pg. folder "Conversion Factors and Formulas for Electrical Engineers" has just been published by the I-T-E Circuit Breaker Co. Contains over 600 conversion factors commonly used by electrical engineers as well as definitions of basic electrical units, prefixes, mensuration and temperature conversion factors. The lists are arranged for use in a loose-leaf binder or for desk or wall mounting. Factor tables have been lacquered to add durability.

14 **D-C Resistance Measurement**—A bulletin just issued describes three types of the company's "Megger" instruments for measuring low resistance. These include a combination Wheatstone bridge and insulation tester; a low resistance ohm meter which operates by pointer deflection down to 0.000001 ohm; and a circuit testing ohm meter which reads from a fraction of an ohm up to 200,000 ohms. James G. Biddle Company.

15 **Switchboards and Switchgear**—Described in new 170 pg. catalog is complete line of Pelham switchboards, panelboards, switchgear, fuses, lugs and other accessories. Contains wiring diagrams, motor circuit data, properties of conductors and other handbook data for electrical men. Pelham Electric Mfg. Corp.

16 **Electrical Insulating Materials Manual**—Handy 32 pg. file-size manual provides engineers and designers with concise, authoritative data on various types of electrical insulating materials. Headings include: Theory and behavior of dielectrics, mica and mica plate, varnishes, inorganic insulations, properties of insulating materials. William Brand & Co.

PACKING, GASKETS

17 **Mechanical Packing Handbook**—New 76 pg. handbook describes varied types of Chesterton mechanical packings for reciprocating rods, rotary or centrifugal rods, hot and cold water, hot oils, solvents, etc. Contains conversion tables for cutting ring packings and other useful engineering data. A. W. Chesterton Co.

18 **Gasket Material**—Flexrock Co., 3677 Filbert St., Philadelphia 4, Pa. 4-page leaflet discusses Plastic-Gasket, a gasket material that can be applied to surfaces of flanges, etc., about 1/64 in. thick, with knife or fingers. Plastic-Gasket is said to prevent leakage, oxidation and corrosion.

PIPING, VALVES, FITTINGS

19 **Pipe, Conduit Gage**—These new gages are described in a recently-issued bulletin. The gage is said to measure any size pipe, electrical conduit and electrical metallic tubing. The gage is small enough to be carried in the pocket yet will measure tubing from pencil size up to 12 in. pipe. Three-Point Gage Company.

20 **Couplings**—A new catalog describing a new coupling is being issued. It is pointed out that this new coupling has been designed for much larger maximum bore to permit the use of smaller size couplings than would ordinarily be required. John Waldron Corporation.

21 **New Steel Weldvalves**—New catalog issued by Manning, Maxwell & Moore, Inc., describes their Hancock Weldvalve in gate, globe and angle designs, 600 lb. through 2500 lb. standards. These Weldvalves are said to eliminate or neutralize valve joints, seat ring joints, bonnet joints and improve packing gland joints; also effect major savings in weight (30% to 60%), space, parts, replacements, maintenance and lagging expense.

22 **Liquid Meter Valves and Slides**—New bulletin tells about self lubrication, quiet operation, light meter valves and slides. Widely used for gasoline, chemical processing, corrosive liquid, acid and alkali valves. Morganite Brush Co.

23 **Flow Control**—This bulletin presents an overall picture of the various valves in the company's line which are available for the solution of various flow control requirements. Each valve is pictured for ready identification. The Wm. Powell Company.

24 **Solenoid Valve**—This bulletin 461 describes and illustrates the V5-200 solenoid valve for use with CO^2, air, water, hydraulic fluids and other media. It points out how the features—such as soft seats eliminating leaks and impregnation of the coils resisting moisture—make the unit highly useful. Allied Control Valve Co., Inc.

25 **Relief Valves**—Power, marine, process, industrial and petroleum relief valves are covered in this bulletin. Lists of characteristics and features are given as are diagrams of the valves. Ordering information is a handy section of the catalog. Lombard Governor Corporation.

26 **Steam Hook-Up Book**—Many practical ideas on how to enlarge the capacity of steam heating lines and heating coils will be found in the Sarco Hook-Up book. Contains recommendations and sketches for fitting Sarco traps, strainers and other products into your plant operation. Sarco Co., Inc.

27 **Expansion Joints**—Wide range of expansion joints for controlling low or high pressure steam, hot water, gasoline, oil, air, or other pipe lines is described in catalog No. 35-P. American District Steam Company.

28 **Unions Booklet**—Specifications tables, size lists, line drawings keyed to the tabular material for quick reference make an excellent data book on the various types of pipe couplings manufactured by the company. Other sections of the booklet tell of the unions' features—their construction, material and appearance. Jefferson Union Company, Inc.

29 **Flexible Pipe Joints**—Bulletin describes Flexo Joints used wherever flexible or swing pipe joints are required for conveying steam, compressed air, water, oil, and other fluids under high or low pressure. May also be used on suction lines. These joints will swivel through 360 deg., with no restriction in flow. Flexo Supply Co.

Coupon must be filled in completely to secure literature you request. Pasting coupon on penny postcard saves time and money.

APRIL, 1946

POWER PLANT ENGINEERING

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Chicago 4, Illinois

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Company Address .....

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(If you prefer delivery at your home also fill in below)

Home Address .....

City ..... State .....

30 **Swivel Pipe Couplings**—A bulletin on the operation and construction of this company's swivel pipe coupling is offered. Features of the coupling, emphasized by line drawings, are presented and the characteristics of the product are described in detail. A full page of engineering and procurement data is a feature of the book. Snyder Sales Corporation.

WATER TREATMENT, pH CONTROL

31 **Water Treatment**—Necessity for correct boiler water treatment and a listing of the advantages obtainable with clean water are described in this bulletin. The costly results of lack of conditioning are shown. Aiken-Murray Corporation.

32 **pH Control**—A new bulletin, No. pH1302, describing the company's line of pH control instruments, has just been announced. pH controllers and recorders are described in detail including electrode assemblies and accessories. The bulletin includes engineering and technical information relative to pH theory and measurement. A variety of actual installations are described with chart records, photographs and flow diagrams included. The Bristol Company.

33 **Water Treating Handbook**—This booklet starts with the known fact that water contains impurities and the acknowledged fact that it is necessary to remove or neutralize them and works its way, through logical sequence to the methods and mechanism of treatment. The company's preparations are described and drawings illustrate methods of introduction to the line. American Sand-Banum Co., Inc.

34 **Feedwater Treatment**—Bulletin No. 30 is featured by the inclusion of 102 questions and answers on feedwater treatment compiled under the direction of the N.A.P.E. Educational Department. National Aluminate Corp.

35 **Chlorine Control Book**—New 88 pg. data book describes this company's equipment and improved methods to step up boiler efficiency and prevent scale, corrosion, and embrittlement. W. A. Taylor and Co.

36 **Steam Line Corrosion Treatment**—Illustrated folder explains how Saverite steam line corrosion treatment is applied and how it dissolves scale, rust, and other elements in pipes. Saverite Engineering Co.

37 **Chemical Proportioning Pumps**—Handsomely illustrated Catalog No. P-41 gives specifications and advantages of Hills-McCanna chemical proportioning pumps. Photos of typical installations. Hills-McCanna Co.

38 **Chemical Scale Removal**—Announcing illustrated booklet "More Power to America's Industry," describes the simplified Dowell chemical method of cleaning scale and sludge from boilers, condensers, engine cooling jackets and other heat exchange equipment. Contains results of typical Dowell applications. Dowell, Inc.

39 **Water Conditioning**—A handbook on water softening is the virtual result of efforts by this company on the latest addition to its softener literature. Well illustrated, carefully departmentalized, the book starts by describing the needs for conditioning equipment, the benefits of soft water, carries the reader to descriptions of water filtering processes, use of activated carbon, iron removal equipment, oil removal filters, aerators and degasitors, chemical feed systems Elgin Softener Corp.

PRIME MOVERS

40 **Steam Turbines**—De Laval Steam Turbine Co. 24 pg. catalog No. 1181 explains complete line of steam turbines, helical gears, centrifugal pumps, centrifugal compressors, worm-gear speed reducers and IMO oil pumps.

41 **Two-Cycle Diesel Engines**—Bulletin 122 gives operating details and shows installation photos of Nordberg stationary 2 cycle Diesel engines. Sizes range from 750 to 8500 BHP. Nordberg Mfg. Co.

PLANT ACCESSORIES

42 **Controlling Corrosion by Deaeration**—A restatement of the science of deaeration and its effectiveness in controlling corrosion is the major part of a 20 pg. booklet just issued by the Elliott Co.

43 **Extraction Steam Heaters Explained**—An informative bulletin on Extraction Steam Heaters has just been prepared by The Griscom-Russell Co. It describes extraction heaters of both horizontal and vertical types, for high, medium and low pressures. Cross-section diagrams graphically explain operation as well as constructions. Also discusses the G-R exclusive visible pressure seal of breech-block heads, self-adjusting compression ring gaskets.

44 **Steam Jet Ejectors**—This well-arranged bulletin gives, in handy form, the engineering data on the ejectors, tables of approximate ejector capacities, air-vapor mixture ratings and data required for quotation. Ross Heater & Mfg. Co., Inc.

45 **Refrigeration Compressors**—Engineering and specifying information along with dimensioned drawings and photos of typical installations make this manual helpful. Features of the equipment are outlined. Worthington Pump & Machinery Corp.

46 **Lubricators**—Catalog 25-D describes the individual pumping units on the company's lubricators for each point to be lubricated. It points out how any pumping unit can be removed or replaced without stopping the engine or affecting other units. Manzel Brothers Company.

47 **Steam Jet Ejectors**—Containing useful data and helpful information on the company's single stage steam jet ejectors, this new bulletin has many desirable features. Among these are: list of industrial applications; engineering data; table of ejector capacities; formula and table of air-vapor mixture ratings; dimensional drawings and tables of sizes. Ross Heater & Mfg. Co., Inc.

PUMPS

48 **Oil Lubricated Turbine Pump**—New bulletin with large sectional drawing describes solenoid oiler, inclosed impellers, automatic clutch and other features of Fairbanks-Morse turbine pumps. Includes tables of sizes and rates, other useful pump data. Fairbanks, Morse & Co.

49 **Pump Reconversion Kit**—The "Reconversion Inventory Kit" will speed the task of determining the condition of your centrifugal pumps. Check list helps locate trouble spots and clear them up. Similar kits cover motors and V-belt drives. Allis-Chalmers Mfg. Co.

50 **Centrifugal Pump Handbook**—"Self-Priming Centrifugal Pumps," sets forth in easy-to-understand style, principles of centrifugal action, physics of pumping, evolution of self-priming centrifugal pumps. The handbook tells the difference between the types of self-priming centrifugals, points out where self-primers can be used with best effect, explains how to install and-care for them. Marlow Pumps.

CONTROLS, ALARMS

51 **Feedwater Control System**—A performance report has been prepared by this company on the feedwater control system for the world's largest forced-circulation boiler, the unit at Somerset Station of Montaup Electric Co., Mass. Besides complete illustrative material, listings of operating data and steam flow charts, the report shows a schematic diagram of the feedwater control system. Northern Equipment Co.

52 **Gas Detection, Warning**—A method for detecting and giving audible warning of hazardous gas or vapor conditions is described in bulletin No. 1116E. The bulletin tells of the various combinations possible with the system. Photographs show how the control panel is placed in a gas-free area with the explosion-proof analyzer heads in areas where the dangerous gases may originate. Included also is a description of the principle upon which the system operates, the method of operation, and a schematic diagram of a typical installation. Davis Emergency Equipment Company.

53 **Control System for Oil Burners**—Actuated by light, this control system is suitable for both domestic and industrial oil burners. Bulletin V-6 describes controls for domestic oil burners, and bulletin V-4 covers industrial oil burners. The Mercoid Corp.

54 **Temperature Control Equipment**—This new catalog describes the manufacturer's automatic temperature control equipment applying to heating, ventilating, cooling, air conditioning, and industrial processing. Johnson Service Co.

55 **Pressure Regulator**—The type 2-80 regulator is described in this bulletin No. 1245, which contains a cutaway illustration of the device in three colors. the illustration clarifies the unit's operation for the engineer. Construction features of the regulator—its wide operating range; spinning pilot valve; positive action; adjustable response; simplicity—are described. Hagan Corporation.

56 **Combustion Control**—Combustion control handbook describes the company's automatic combustion control for all sizes of boilers. The book is packed with line drawings of typical installations, tabular material, specification data and photos. Sequences of operation and details of construction are given. Brooke Engineering Company, Inc.

57 **Flame-Failure Safeguard**—A flame-failure photoelectric safeguard is described in this bulletin. The hazards are described and then the operation of the safeguard is detailed. The bulletin is well arranged. General specifications are given. Combustion Control Corporation.

MISCELLANEOUS

58 **Rod and Tubing**—A comprehensive bulletin describing cast bronze in rod and tube form has just been issued. Tables of alloys and sizes, physical properties, typical specifications are presented. Ampco Metal, Inc.

59 **Power Brushes**—A virtual encyclopedia of power brush usage in manufacturing operations has just been issued by this company. The book is generously illustrated and the contents include a full-page treatise on factors that enter into the selection of brushes. Fifteen separate tables give detailed information on a variety of factors entering into efficient power brushing operations. Some of the achievements possible with proper brushes and suggested techniques are presented. The Osborn Manufacturing Company.

60 **Silicone Compounds and Greases**—New bulletin tells how Dow Corning silicones are used as heat stable compounds for sealing aircraft engines and radar equipment; as lubricants for valves and bearings operating at extremely high and low temperatures; as heat resistant, waterproof varnishes and resins in electrical insulation. Many charts and tables. Dow Corning Corp.

61 **Hydraulic Machinery**—An 8 pg. brochure that completely outlines the company's expanded facilities is available. It describes the engineering, laboratory and production department and illustrates typical examples of special and hydraulic machinery. Hydraulic Machinery, Inc.

62 **Progress**—A history of the company's manufacturing progress since 1859 is detailed in pictures and text in a recently issued booklet. Plant process, typical installations of company equipment, history and organization, war activities and other interesting highlights are presented. Gardner-Denver.

63 **Magnetic Drives**—A data booklet that starts out with a detailed description of the method of regulating the output of mechanical draft fans with these magnetic drives. Next, a section is devoted to a report on how the drive itself works. Both sections are illustrated and performance curves are given. Parts are illustrated and line drawings show how the drive is adaptable to various requirements. Electric Machinery Mfg Co.

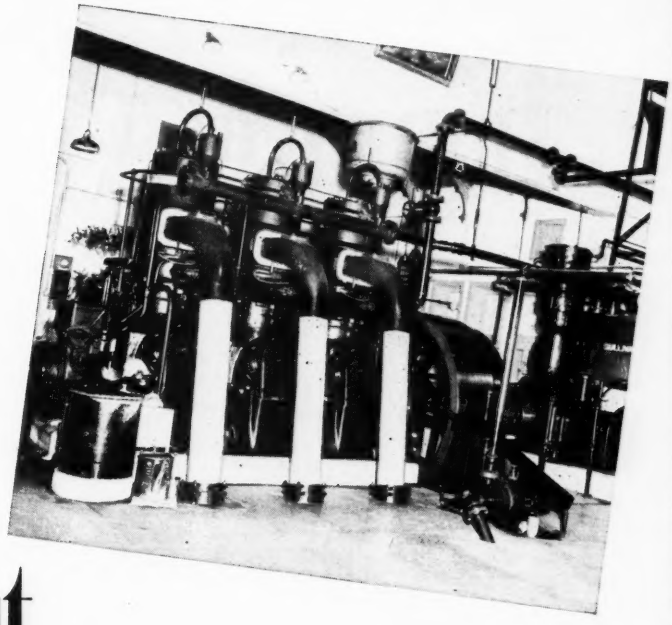
64 **Post-War Products**—This is a brochure covering a preview of the company's products for sale in the post-war era. Among the items shown are high voltage motor generator sets, materials handling, battery charging and electrical testing, electric power units, buffers and grinders. Motor Generator Corp. Div., The Hobart Brothers Company.

65 **Polishing Wheels**—This bulletin describes the manufacturer's new finishing and polishing wheels which are available in several resiliencies. Features of the wheels, details of their construction, performance characteristics are given. A table of safe maximum operating speeds for each type of bonding material is included. The Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc.

66 **Paper Reprints**—Reprints of the paper "Hydrocarbon Thermodynamics," presented by W. C. Edminster at the November, 1945, meeting of the California Natural Gasoline Assn., are available on request. Foster-Wheeler Corp.

(Continued on page 166)

Saves two overhauls and 20% of lubricant cost



NONPAREIL HD
DIESEL OIL

Since changing to Nonpareil HD Diesel Oil, a Midwestern city water department has had 15 months of uninterrupted service from its 150 H. P. Diesel. This engine operates under difficult conditions. Before Nonpareil HD was installed, it had been necessary to shut down every six months to free stuck rings and to clean carbon.

Thus, during 15 months of service, Nonpareil HD eliminated two tough jobs of overtime maintenance work. In addition, it saved 20% in oil costs.

Nonpareil HD Diesel Oil is one of two types supplied by Standard for industrial Diesels. It is an oxidation inhibited and detergent oil for heavy duty service. Standard also supplies Nonpareil Diesel Oil, a highly refined, clean operating, straight mineral oil. A Standard Oil Lubrication Engineer can give you an unbiased recommendation on the oil you need to get low cost, reliable service from your Diesels. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Improved STANOILS

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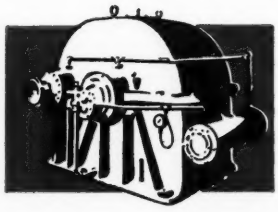
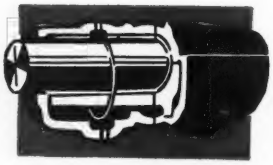
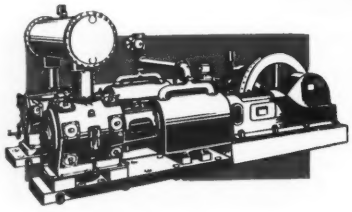


...in bearings



...in compressors



...and hydraulic systems

STANOILS have long been outstanding for relative freedom from deposit formation, and for their long lasting quality in all types of service. Now by the addition of an oxidation inhibitor, developed by Standard Oil, the oxidation stability of Stanoils has been improved many-fold.

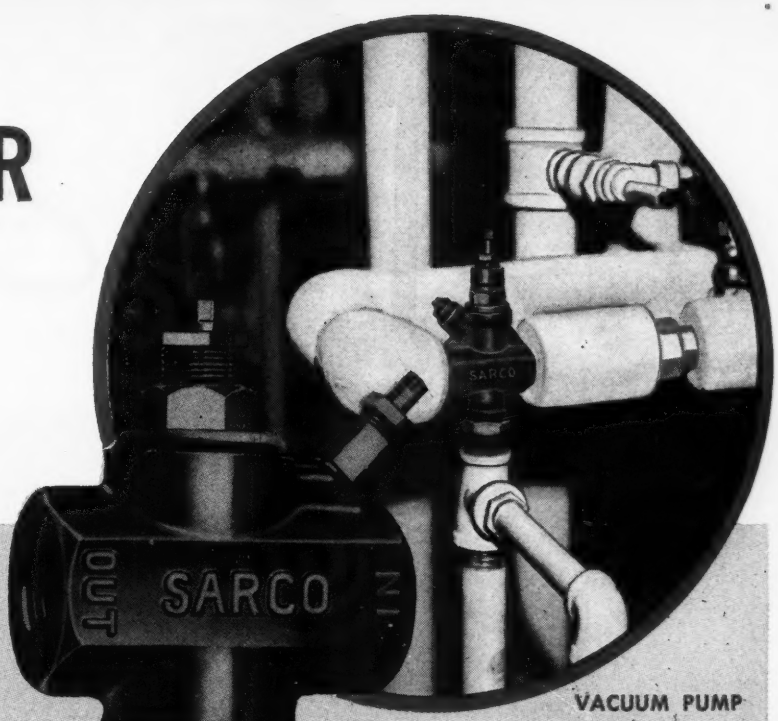
With improved Stanoils, oil acidity will remain at a safe low figure for long periods of operation. At the same time, deposit formation is practically eliminated. In addition, an effective defoaming agent is used.

These advantages can be secured for a variety of applications, because improved Stanoils are available in a wide range of viscosity grades. In fact, you may find that Stanoils can be applied to all your lubricating jobs, with consequent simplification of ordering and stocking.

A Standard Oil Lubrication Engineer will be glad to help you test improved Stanoil and point out equipment in your plant in which the high stability and clean operation of Stanoil can save maintenance time and money. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

THE REGULATOR of cooling operations everywhere



VACUUM PUMP

TR-40

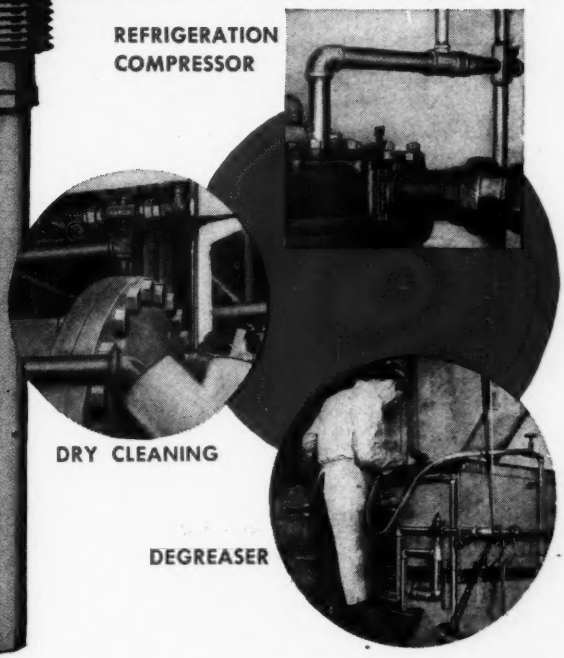
COOLING CONTROL

Few devices cost so little and save so much—because the Sarco TR-40 saves in many ways.

It saves water because only enough can pass the valve to hold the temperature desired. It increases engine efficiency by maintaining correct jacket temperatures. It saves lubricating oil—prolongs the life of the equipment.

On condensers and stills it saves up to 50% of the water and insures dependable process operations. It boosts production on degreasers and other tank control processes.

Available in sizes ⅜ to 1 ½ inch. Calibrated for any temperature between 40 and 200 degrees F. Ask for Bulletin No. 700.



REFRIGERATION COMPRESSOR

DRY CLEANING

DEGREASER

126

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

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Six weeks

All Hagan control systems are designed on the principle that *control* and *metering* are separate functions. Only when these functions are kept independent of each other can control equipment have the dependability, ruggedness, sensitivity and speed of response that are essential for the proper operation of Automatic Combustion Control Systems.

fuel savings PAID FOR HAGAN CONTROL

When the new fuel engineer of a Pittsburgh District steel plant called in a Hagan representative, he was worried by something more serious than excessive fuel consumption. He was unable to get steam enough from two 500 hp boilers to meet peak demands of the plant.

Steam is employed in this plant for heating; for atomizing the oil used in the furnace burners; and for descaling and other plant operations. During periods of maximum demand, steam pressure often dropped to such an extent that the efficiency of the furnaces was impaired and operations in the plant were delayed.

An additional boiler seemed to be needed, but that would have required W.P.B. approval and would have involved an investment of nearly $40,000.

The Hagan engineer recommended the installation of a Hagan Master Regulator and two Hagan Furnace Draft Controllers. Total cost—less than $1,000.

That was nearly *three* years ago. During that whole period there has been no difficulty in maintaining constant steam pressure in spite of wide fluctuations in demand.

Furnaces have operated more efficiently, because steam for atomizing the oil is always at the desired pressure.

Delays in plant operations, due to low steam pressure, have ended.

These results more than justified the installation—but they are only part of the story.

Boiler efficiency rose, coal consumption dropped, and savings of more than $25 a day resulted. In six weeks, fuel savings paid the cost of the control system—and that saving has continued ever since. In three years, the $1,000 investment has returned more than $26,000 in dividends!

If you want more efficient boiler operation and lower fuel consumption, arrange to have a Hagan engineer visit your plant. He will be glad to survey it and make recommendations, without any obligation on your part.

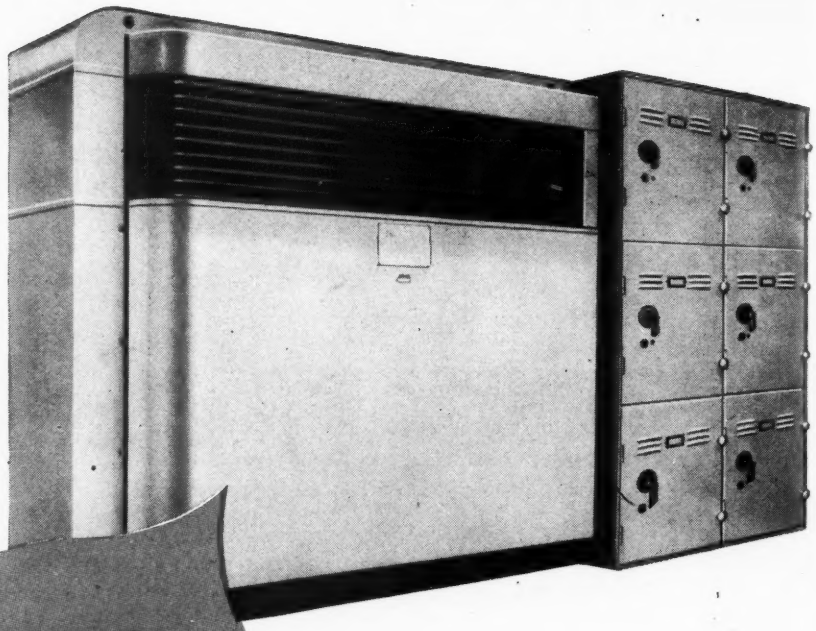
HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

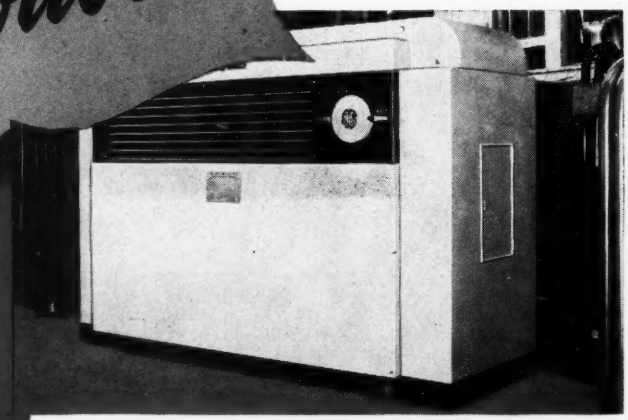
The pioneer . . . and still the leader

A typical G-E dry-type substation, made up entirely of standard elements and equipped with metal-enclosed, drawout air circuit breakers. Units like this can be added one-by-one until your entire plant is converted to a co-ordinated load-center system.



SOUND DESIGN *inside and out...*

DRY-TYPE



A "bright spot" anywhere in the plant, this G-E dry-type load-center unit substation (150 kva) is completely self-contained, incorporating high-voltage potheads, disconnecting switch, fuses and low-voltage thermal breakers.

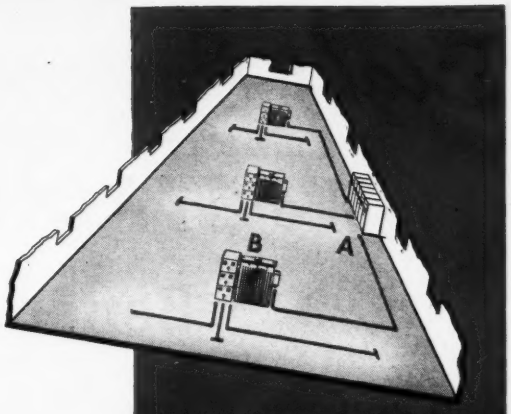
G-E dry-type unit substations are styled to meet 1946 requirements for neatness and clean-cut appearance in your plant equipment-layout. Their design simplicity lends itself to ease of location and facility of installation. Their light weight reduces structural problems.

Users who prefer dry-type equipment will find these unit substations at the top of their class in their ability to handle overloads. For, the transformer sections of G-E dry-type unit substations are designed to meet AIEE Standards No. 1 for Class B insulation, with *130 C maximum hot spot temperature* in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

These unit substations have factory-matched switchgear —that is, the interrupting capacity of the switchgear section is matched, electrically, mechanically, and thermally, with transformer characteristics.

G-E dry-type unit substations are repetitively manufactured. This is a feature adding to their flexibility, for as load requirements change, expansion is met by the addition of similarly matched units, block by block. Thus, a planned efficient load-center power distribution system is always in operation in your plant. G-E dry-type unit substations are available in ratings up to 2000 kva, 15,000 volts.

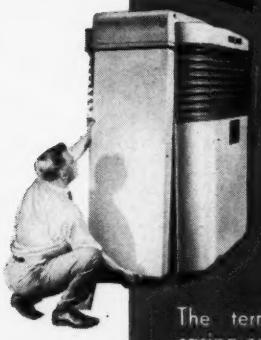
Ask for bulletins GEA-3592A and GEA-3714B. Call your nearest G-E representative or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



In a modern load-center distribution system, power is distributed from metal-clad switchgear (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through short secondary feeders.

UNIT SUBSTATIONS

G-E dry-type unit substations have been supplied in quantity since early in the war-construction period, and sizes and types to meet individual load conditions can now be ordered "right out of the catalog."



The terminal compartment casing extends down the entire side of the substation, facilitating cable entrance connections. The unit can be moved into place after conduit and cable have been made up. On vital conversion jobs, this convenience feature will save many precious hours.

GENERAL ELECTRIC

321-44-5900

Eight Improvements

GENUINE make STRONG 70 Series Traps Better than Ever!

Look at these new features:

1 Renewable seat replacing pressed-in design;

2 Anum-Metl* valve and seat with new scientifically designed Hi-Cap* (patent applied for) orifice . . . up to 25% greater capacity;

3 Oversize inlet and outlet ports—increased flow capacity;

4 Relocated inlet and outlet connections—avoids backflow on light loads;

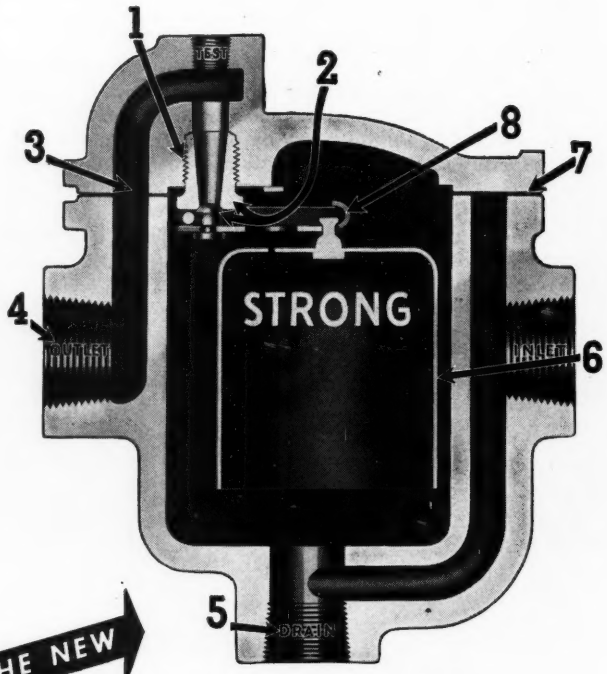
5 Drain connection added—available for bottom inlet;

6 One-piece, deep-drawn, stainless bucket—no welds;

7 Larger gasket area—means positive seal;

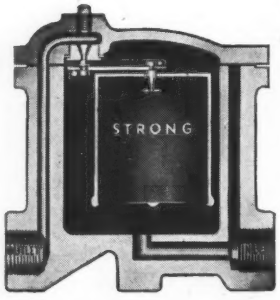
8 New, improved, stainless, high-ratio leverage.

Plus Adaptability to older models with change-over assembly including Hi-Cap orifice.



New 70 Series Strong Trap, No. 170

COMPARE THE NEW WITH THE OLD



Old 70 Series Strong Trap

In improving the 70 Series trap, Strong has remembered the thousands of older style 70 Series traps still in service after many years. Each improvement bears the "proof in service" label, so Strong quality remains uniformly high. Service continues to be available on all Strong traps, and they can be completely modernized to include the improvements listed above.

With a complete line of Strong open and inverted bucket traps at their disposal, Strong engineers can specify exactly the right type of trap for your particular application. For full details, write for the new Strong Catalog No. 67.

STRONG, CARLISLE & HAMMOND COMPANY, Cleveland 13, Ohio

*Registered Trade Mark

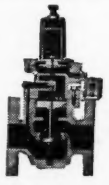
REG. TRADE MARK

OTHER STRONG STEAM SPECIALTIES

ANUM-METL Reg. Trade Mark

Strainer

No. 80 Series Trap



Reducing Valve

Material sold by Mound City Erection Co., St. Louis, Mo., approved K & M distributors in this area.

ASBESTOS IN ACTION

BUILT TO LAST

Here is a roofing and siding that defies time and wear

K&M *"Century"*

ASBESTOS CORRUGATED

This interesting St. Louis plant follows a modern trend in industrial building construction. The exterior of the building, involving a total area of 200,000 square feet, is completely clad with one of the toughest and most durable of all sheathing materials . . . K&M "Century" Asbestos Corrugated roofing and siding.

Whether your building plans call for new construction, remodeling or repairs, it will pay you to investigate the many distinctive features of K&M "Century" Asbestos Corrugated and Flat Lumber.

TOUGH . . . made of asbestos and portland cement combined under tremendous hydraulic pressure.

ADAPTABLE . . . for all types of industrial buildings—new construction, remodeling, repairs.

ATTRACTIVE . . . has neutral gray color, practical finish, never needs protective paint.

LONG LASTING . . . will not rust, corrode, rot . . . proof against weather, rodents, termites.

FIRE RESISTANT . . . thus earning low insurance rates.

TIME SAVING . . . comes in 19 different lengths and one standard width . . . easy to handle . . . goes up fast.

Build to last, and save time and money the "Century" way. Bring your problems to your authorized K&M Distributor. He is well equipped to meet your material and installation requirements for "Century" Asbestos Corrugated and Flat Lumber.

Nature made Asbestos . . . Keasbey & Mattison has been making it serve mankind since 1873.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

MARLEY NOZZLES

3 Ways to Perfect Sprays

One of these three Marley Patented Spray Nozzles will perform with peak efficiency in any spray requirement. The patented design achieves maximum break-up and uniformity of distribution without moving parts. Of durable bronze, these nozzles are available with male and female pipe connections; and in a wide range of sizes and capacities.

ATOMIZING NOZZLE: For any service requiring a mist-like spray, such as maintaining humidity for heating and processing, conditioning perishable foods, and for atmospheric absorption. It is fitted with a Monel metal screen to prevent clogging and may be cleaned easily.

TWO-PIECE NOZZLE: Features the removable plug for quick cleaning without removal from pipeline. In any service where clogging is a problem, the Marley Two-Piece Nozzle is the answer.

ONE-PIECE NOZZLE: Built for maximum uniform output at lowest pressure. This nozzle is non-clogging under normal conditions and will render years of efficient trouble-free service.

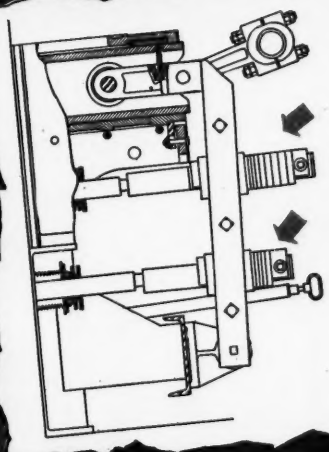
Write for Marley Nozzle Bulletins or ask a Marley Application Engineer to assist in selecting the proper nozzles for your job.

MARLEY NOZZLES

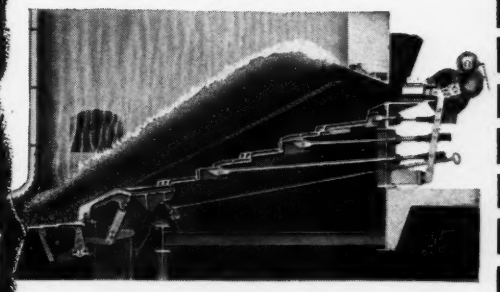
THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

What a Whale of a Difference!

. . . BUT THE BASIC PRINCIPLE IS STILL THE SAME



SIMPLIFIED FRONT END DRIVE WITH PRECISION — ADJUSTABLE — INDEPENDENT PUSHER CONTROLS



IMPROVEMENTS Make the Difference in Æ Taylor Stokers, Too!

IF YOU examine today's Æ Taylor Stoker, you'll find embodied in *all* its advanced engineering features a singleness of purpose—dependable, low cost steam generation. A typical example is the secondary pusher control feature of the simplified front end drive. These pushers move the fuel with precision throughout its travel on the grate because they operate independently of the coal rams, with basic stroke settings adjustable within ⅛-inch to prevent overshooting. The few modifications necessary can be readily made in operation.

Engineering improvements such as this have continuously increased the efficiency of the inclined multiple retort underfeed firing principle first established by Æ 40 years ago. Under radically changing conditions it has been economy-proved time and again in hundreds of installations of all sizes.

When comparing *any* fuel firing equipment, remember that the modern Æ Taylor Stoker offers you Æ pioneered *basic* advantages combined with exclusive mechanical *improvements*. Complete details are shown in Catalog R-A. Write for it, or ask our engineers to answer your technical questions.

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

Æ

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

AMERICAN ENGINEERING COMPANY

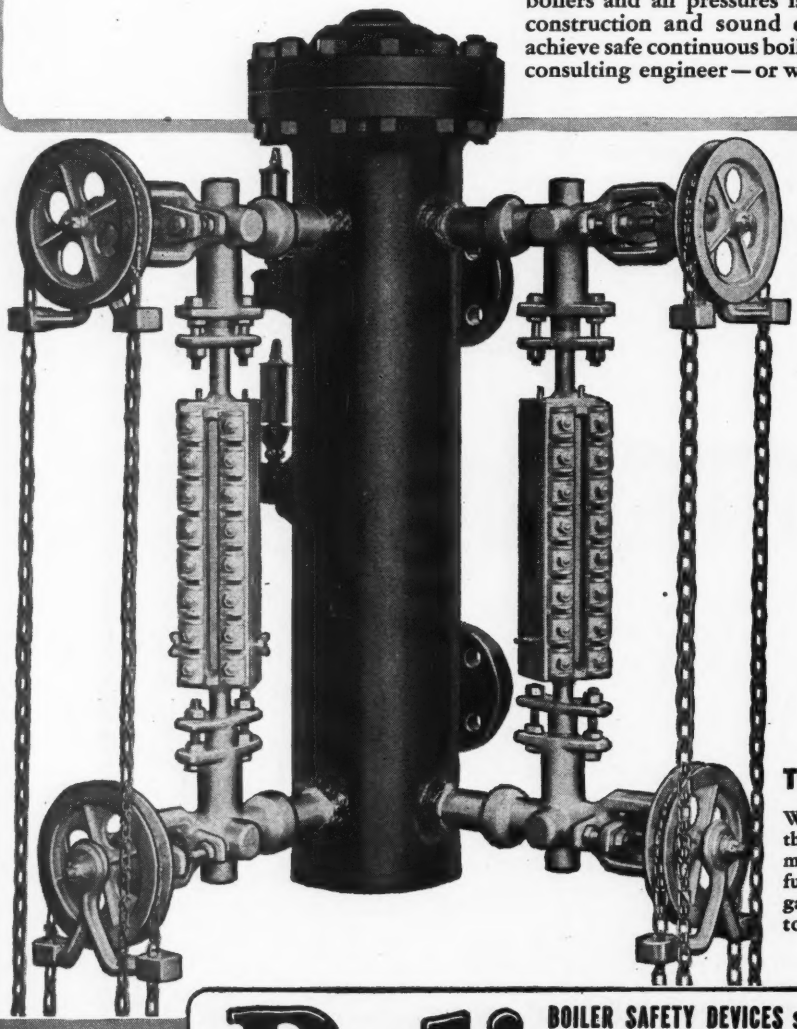
2408 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

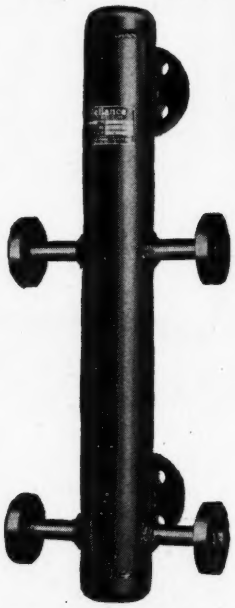
You insure *Smoother Power Control* and safe, continuous boiler operation with

Reliance

WATER COLUMNS AND WATER GAGE EQUIPMENT

● Smoother power control begins at your boiler drums where Reliance Boiler Safety Equipment gives you the primary check on vital water levels. The Alarm Water Column with its positive action float-operated mechanism gives you an audible warning at the approach of dangerous water stages—high or low. Various types of water gages of latest modern design, valves, gage inserts and illuminating equipment furnish accurate, easy-to-observe water level readings. Reliance Equipment for all types of boilers and all pressures is noted for its quality, sturdy construction and sound engineering. It helps you to achieve safe continuous boiler operation. Check with your consulting engineer—or with a Reliance Representative.





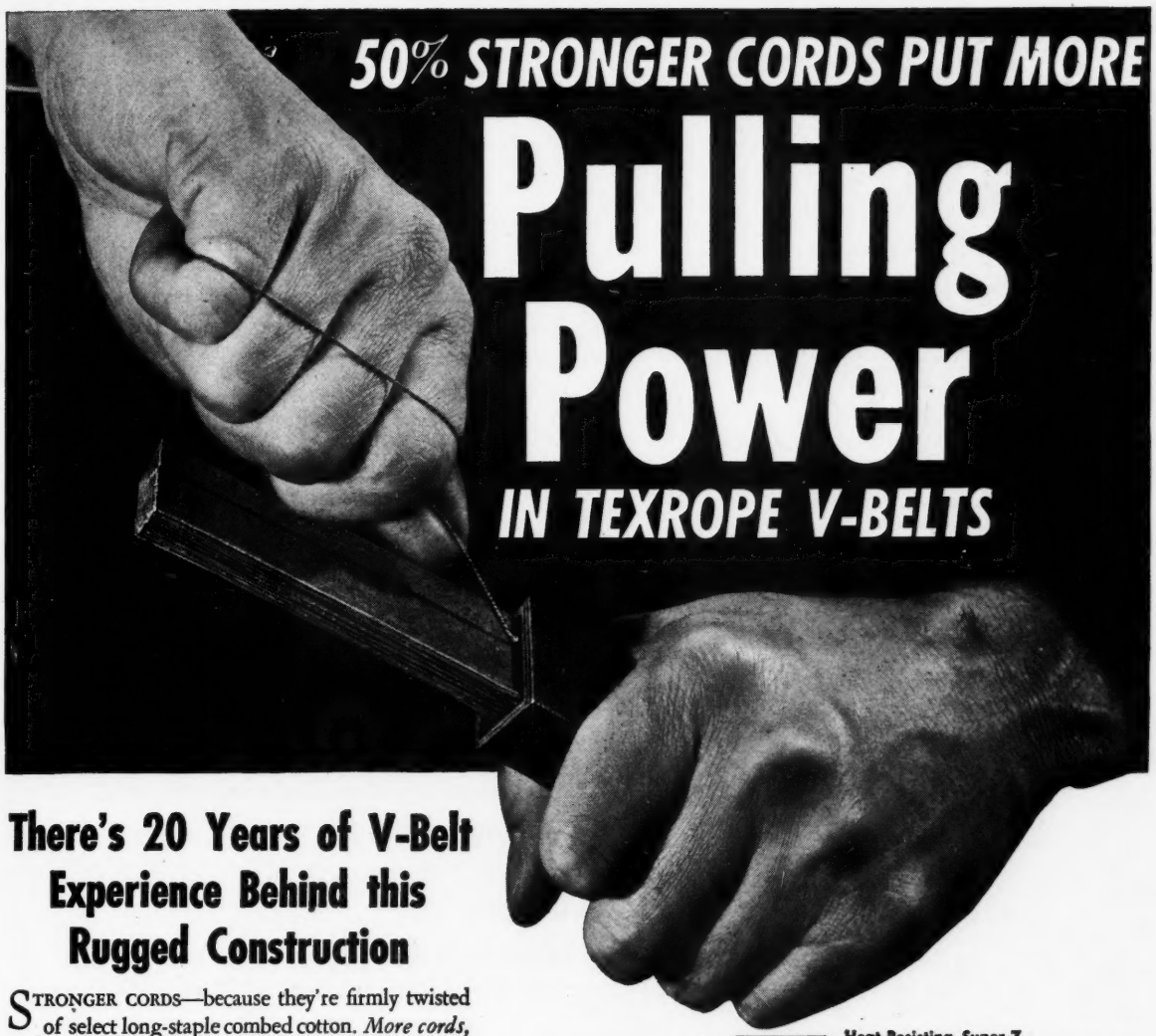
Twin Gage Technique

Wider use of higher pressures heightens the need for correct use of dual gages to meet boiler code requirements. Reliance furnishes steel water columns with twin-gage assemblies or all-welded direct-to-drum gages of approved design.

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO



50% STRONGER CORDS PUT MORE Pulling Power IN TEXROPE V-BELTS

There's 20 Years of V-Belt Experience Behind this Rugged Construction

STRONGER CORDS—because they're firmly twisted of select long-staple combed cotton. *More cords,* too — accurately placed to carry heavier loads, and impregnated with gum rubber to absorb friction and heat.

Texrope "Super-7" V-Belts today are the finest in 20 years of continuous development by Allis-Chalmers—originator of the multiple V-Belt drive.

LONG WEARING — COOL RUNNING

Tough duplex cover to take the wear, keep the belt in shape. *Thick cushion* of war-proved Buna-S to protect the cord structure from shock. *Precision molding* to assure accurate section and a smooth running belt. For long service and highest efficiency on ALL V-Belt drives — make A-C your V-Belt headquarters! ALLIS-CHALMERS, Milwaukee 1, Wis.

WHICH OF THESE SUPER-7 V-BELTS DO YOU NEED

TEXROPE offers you the most complete line of V-Belts — types specially developed to meet ALL operating conditions. Pick the right TEXROPE Super-7 V-Belt — it'll give you the most in efficient power transmission.

Heat-Resisting Super-7
Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

Oil-Resisting Super-7
Neoprene cover protects core against moderately oily or greasy conditions.

Oil-Proof Super-7
Made of Neoprene throughout. Use it when the belt must swim in oil.

Static-Resisting Super-7
Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

Super-7 Steel
Twin steel cables, to pull extremely heavy loads with minimum stretch.

GET THEM — through your Allis-Chalmers district office or dealer.

TEXROPE Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

V-BELTS
TEXROPE complete line — Sizes, types for every power transmission problem and condition.

ALLIS CHALMERS
TEXROPE V-BELT DRIVES
ORIGINATORS OF THE MULTIPLE V-BELT DRIVE

SHEAVES
"MAGIC-GRIP" . . . TEX-STEEL . . . TEXDRIVE . . . Speed changers and VARI-PITCH sheaves.

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

A 2009

How to get more WORK out o

Now is the time when it will pay you to check up on the production efficiency of your processing equipment. Increasing operating speed and reducing heating time will help you meet the rise in manufacturing costs.

Armstrong Steam Traps are helping manufacturers get more work out of their power plant equipment because:

1. They remove condensate as fast as it is formed.

2. They discharge air and other incondensible gases along with the condensate.

3. They give continuous service, even when water conditions are bad, because dirt and sludge are discharged with the condensate and the all-stainless steel mechanisms are highly resistant to corrosion.

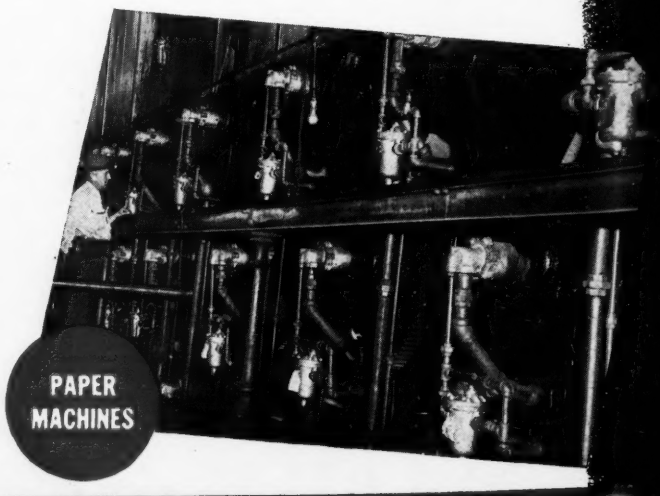
Write for a copy of Armstrong's 36 page Steam Trap Book, and the name of your Armstrong Representative.

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan, U.S.A.

TRAPPING TIPS*

1. Use a trap on each unit.
2. Wherever possible, install the trap close to and below the unit being drained.
3. Use traps that automatically discharge air as well as condensate. Where extra air handling capacity is required, check with your Armstrong Representative.
4. Avoid using traps that require the condensate to cool before it can be discharged.
5. Avoid using undersize traps. Allow an adequate safety factor to handle peak loads.

*The ARMSTRONG STEAM TRAP BOOK contains complete data on trap selection, including calculation of condensation and heat transfer rates plus recommended safety factors. Ask for a copy.



ARMSTRONG

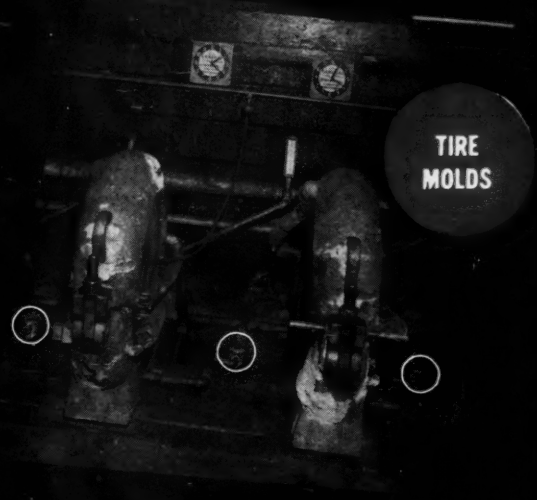
Over a Million in Use!

steam heated *Process Equipment*

LAUNDRY DRIERS

AUTO-CLAVES

PLASTIC PRESSES

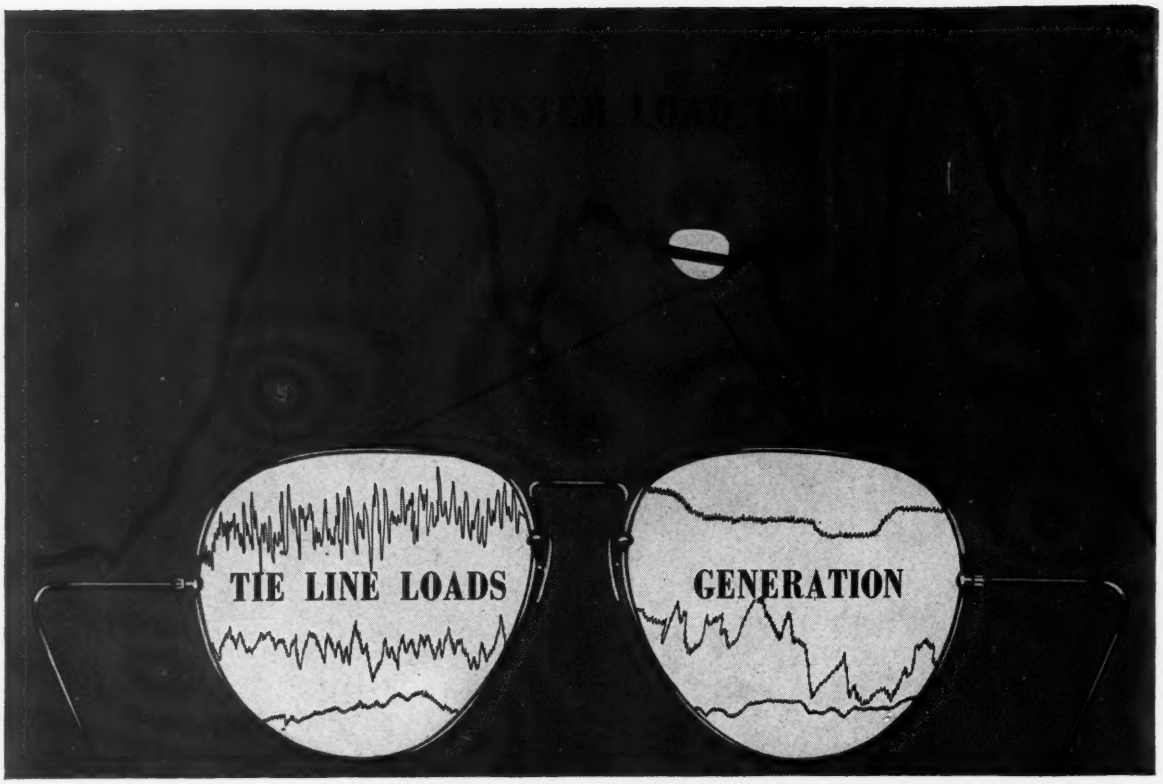


TIRE MOLDS

JACKETED KETTLES

Inverted Bucket **STEAM TRAPS**

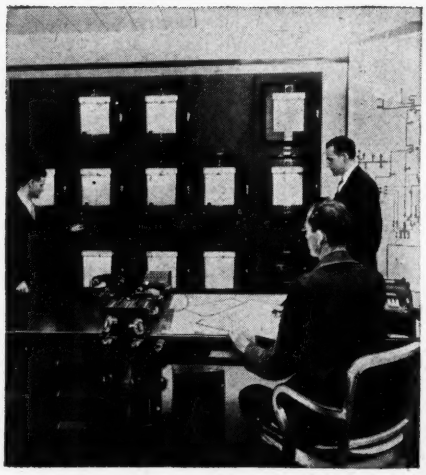
For Power Process Heating



LOOK AT LOAD THROUGH THE DISPATCHER'S EYES

When the only load curve a dispatcher sees is plotted from periodic load readings, he does not get a true picture of routine operating conditions. He has to guess at what happens to load during the five or ten minute periods represented by straight sections of the plotted curve. And therefore the dispatcher often learns of critical load conditions so belatedly that the necessary resultant changes in generation upset the efficiency of the system.

To prevent this, the minimum information the dispatcher needs is a continuous record of the interchange on each tie, plus a continuous record of the output of each generating plant. This information is dependably supplied by Micromax Load Recorders. With these instruments, the dispatcher can see actual conditions when they exist—does not depend on telephoned data. He can watch trends and anticipate requirements. He has a heavy responsibility, for operating a large investment in plant equipment. Micromax Load Recorders have been proved to be the proper tools to help discharge this responsibility.



Public Service Co. of Oklahoma uses this panel of Micromax Load Recorders, Frequency Recorder and L&N Load-Frequency Automatic Control, in the Load Dispatcher's office in Tulsa.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

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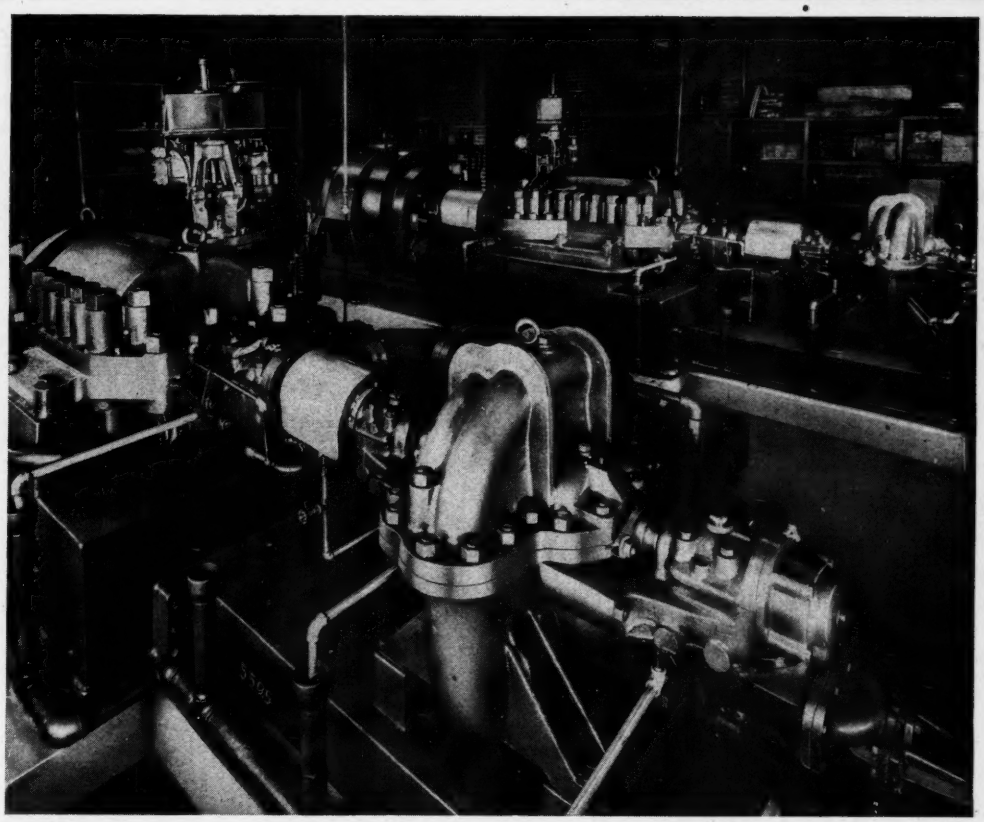
ON and OFF



at 1150 POUNDS PER SQUARE INCH

What could demand more of a high pressure pump than descaling spray service, where pressures of as high as 1150 psi are required, and where sudden changes in delivery from zero to full capacity occur as often as thirty times per hour?

Among the many features responsible for the excellent performance of De Laval pumps under conditions such as these, is the perfect functioning of the De Laval automatic, hydraulic balancing arrangement.

The pumps shown above are installed in a steel rolling mill where four De Laval Pumping Units are employed for descaling spray service. Each unit consists of a seven stage pump in series with a two stage pump and delivers 1000 gpm against 1150 psi.

3240

TURBINES • HELICAL GEARS
WORM GEAR SPEED REDUCERS
CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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Another MAINTENANCE *Record*

for "GUN-PAKT" JOINTS!

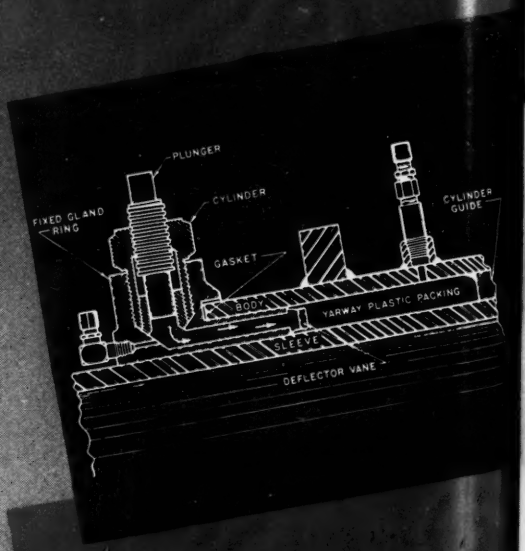
WESTERN UTILITY MAINTAINS ALL YARWAY EXPANSION JOINTS AT COST OF $1.50 PER MONTH FOR PACKING

Over the last 12 years this company has installed 121 Yarway Gun-Pakt Expansion Joints, ranging in size from 3" to 20". During that period they have had to purchase only 76 pounds of packing for these joints . . . at a cost of approximately $1.50 per month. That's to service *all* the Gun-Pakt joints!

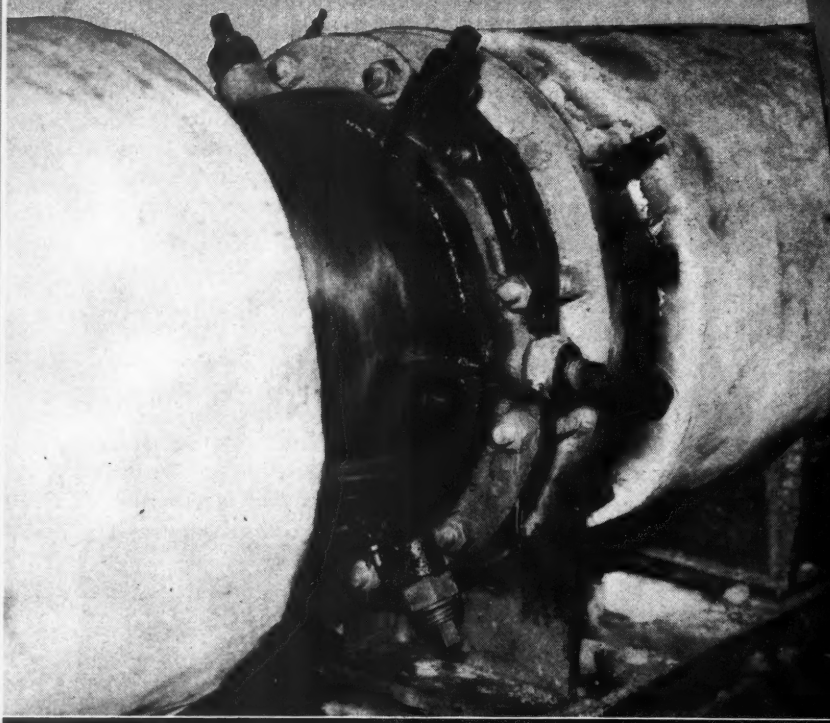
The Gun-Pakt feature is more than an idea—it is a practical improvement in expansion joint design that has saved thousands of dollars in operating and maintenance costs to public utilities and others who have installed them in steam distribution systems. With Gun-Pakt joints there is no need for costly shutdowns for repacking. *They can be serviced under full steam pressure.* Insert a packing plug . . . twist a wrench—the joint's tight, the job's done.

For the full story on Yarway Gun-Pakt Expansion Joints, write for Bulletin EJ-1911.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



Single end, welding-type Yarway All Steel Gun-Pakt Joint, 150 lbs pressure.



YARWAY GUN-PAKT EXPANSION JOINT

Science and the War Effort

By DR. VANNEVAR BUSH

Harris & Ewing Photo

THE mobilizing of science and engineering to share in the nation's defense during these past five years has resulted in great achievements. But those achievements have been attained at very great cost. Wartime research is applied research. Since applied research is essentially a process of converting the results of fundamental research to practical use, war means a great drawing down of our scientific capital of fundamental knowledge at the same time that it prevents any coherent replenishment of that stock. This is the price we pay, and this is a problem to which me must turn with full energies now that the demands of war have been relaxed.

We shall take with us from our war experience into the years of peace various kinds of aid to our attack on this problem. From each of the two groups of physical products of our war research we shall retain and profit by retaining devices, techniques, and concepts. Radar obviously offers perhaps even greater social utility in peace than in war. Obviously, too, any advance in surgery or general medicine made as part of the war effort is of equal value in peacetime. If, as seems justified both by the scientific magnitude of the accomplishment and by the extremely complex international significance attaching to it, we set the atomic bomb —or the control of atomic energy— in a third class apart from these two basic divisions of our wartime scientific and engineering effort, we can properly count a third physical legacy from that effort to aid us in the years ahead.

But beyond these, we shall take with us from that war experience something else, not tangible and immediate, yet of far greater long-term significance. This is a renewed and reinvigorated faith in the vitality of the philosophy of government in which we believe. In the world of today and the world discernible for the decades ahead, there could be for us no more precious result from our war effort than this.

The war was a highly technical affair, and it produced a great experience in teamwork and professional partnership. Under the stress of war, and in the common interest, it is to be expected that men should forget their minor differences and sink their personal ambitions and inclinations in the heat and intensity of a hazardous effort. But never before in history did this occur as it occurred in the manner in which the United States conducted its enormous war effort all over the world.

Military men and scientists arrived at a basis of professional partnership which was extraordinary. Scientists and engineers pulled in the same harness; in fact many scientists became engineers and some engineers became scientists in the process. Scientists from universities and those from industrial laboratories were indistinguishable. Industrialists, government representatives, officers of the services, though they argued the case vigorously when occasion demanded, pulled likewise in the same direction in the end.

In addition, the relations between scientists and engineers of the United States and those of the British Commonwealth of Nations were just as effective as relations within our own country, and this is important.

Now back of this phenomenon, back of all the teamwork in a wholehearted unity of purpose, must lie some great and important causes.

Germany started its war effort many years before the world became properly alerted to the threat, and it began the development of such things as V-bombs many years before we were similarly at work. In certain areas to which great effort was directed, or in which the Germans had natural aptitude, the technical progress of Germany was great, and at times it even led us in techniques. But these were isolated and relatively unimportant instances. In substantially every important area of the scientific and technical war effort the enemy has been outclassed by the great democracies.

There are many reasons, of course. In the latter part of the war the enemy's effort was disrupted by strategic bombing, fortunately for our interests. Slave labor is not efficient labor. But another reason appears to me fundamental. Germany never established partnership, or anything remotely approaching it, between military men and scientists. It never brought its scientists, engineers and industrialists into the common effort with genuine teamwork. Its decisions, on scientific programs, were made in the pattern of all despotic decisions, without the free play and give and take of independent minds, guided by the scientific truth and not by personal fears or ambitions. It badly fumbled the effort at every point.

It failed because the atmosphere of freedom is favorable to that collaboration of men of diverse talents which is essential to the effective prosecution of highly complex undertakings. It failed because the regularity and lack of confusion, which are the pride of totalitarians, are far exceeded in importance in the modern complex world by the effectiveness, by the efficiency, of the untrammelled spirit which develops fully only under freedom.

(Continued on page 144)

Vannevar Bush has had an unusual combination of experience as teacher, research scientist, engineer and administrator. In each field he has served with highest distinction, because he has both breadth and depth in the others. Hence he was a logical choice for the post of director of the Office of Scientific Research and Development, to which President Roosevelt appointed him in June 1941. The results of his work in co-ordinating the scientific resources of the country to win the war—the atomic bomb being the most spectacular but not the only result—are now apparent. He had been since 1939, and still is, president of the Carnegie Institution of Washington. Before that he had served from 1932 to 1938 as vice-president and dean of engineering at MIT, having previously been professor and associate professor of electrical power transmission there since 1919. He was graduated at Tufts as M S in 1913, took his doctor's degree at MIT and Harvard in 1916 and has received honorary degrees from Tufts, Harvard, Johns Hopkins and other institutions. During the first World War he did submarine detection research for the U. S. Navy, after a year of test work with General Electric Co. His outstanding work in power transmission problems, in mathematics and in other branches of advanced electrical engineering, is well known to that field. He built the famous integraph, first of the modern calculating boards, at MIT for solving complex differential equations, a most practical tool in electric system analysis and for solving gunfire problems. He has been awarded the Levy, Lamme, Ballou and Holley medals and other honors, is a fellow of AIEE, member of many honorary and scientific bodies and was chairman of the National Defense Research Committee in 1940.

In recognition of all these achievements, especially those as head of OSRD, the Washington Award was conferred upon him by The Western Society of Engineers at Chicago on February 20, 1946. From his address in accepting this award, the above material has been abstracted.

The Power Plant Goes to Sea— but the Supervision Stays Ashore

Lester M. Goldsmith

Chief Engineer, The Atlantic Refining Co.

Gives stationary power engineers some new slants on reducing losses in power generation and consumption. He shows how it is done in nine 650-psi, 920-F marine power plants. Since these go away from the supervision, the latter must use an unusual combination of design and operating procedures, instruments and automatic controls and engineering auditing to keep the losses at a minimum, performance at a maximum

TWO FUNDAMENTAL THINGS about a marine power plant are vitally different from any power plants discussed here, with particular reference to the reducing of losses in both generation and consumption, which we believe very few people take into account: 1. The power plant goes to sea, but the supervision stays home. 2. The generation and the consumption take place within the same cubicle.

Now let us decide on just what that means. It means that ways must be devised for ascertaining data on operations in the generation and consumption. Strange as it may seem, marine power plants are further behind the times in this very feature than any power plants the writer comes in contact with, or anyone else for that matter. Even our modern Navy does not use flow meters as standard instruments, nor do they have combustion control, feedwater control, dual control, and so on.

But, realizing just what this problem is, as stated in the beginning, we have tried to overcome that lack of supervision by instrumentation, automatic control and engineering auditing.

High-Pressure, High-Temperature Plant for Economy

Now the first place to reduce losses in power generation is, of course, in the design of the power plant. Here again we have departed from the so-called "standard" and have pioneered high-pressure, high-temperature steam. In order to best illustrate what we have done along these lines, we will take the latest design of our fleet, of which there are nine practically identical power plants. Assuming the plant of turbine-electric type, using high-pressure, 650 psi and high-temperature 920 F steam, it was considered highly illogical and inconsistent to use a lot of wasteful steam-driven auxiliaries. Each of these may be a small item in itself, but when all are added together they constitute a considerable drain on overall economy. In addition, unlike the so-called standard ship in the Navy of approximately these steam conditions, we do not desuperheat the steam for auxiliaries, as we consider that wasteful, so we take boiler pressure and

Summary of Loss Reduction Procedures

1. Design of turbine electric drive plants for 650-psi, 920-F operation to get economy of higher steam conditions
2. Auxiliary turbo-generators used; at sea these are motorized to give main excitation, resulting in fuel saving. Automatic throw-over to turbines if main unit speed drops
3. Air puff soot blowers save high-pressure steam and valuable fresh water
4. Complete outfit of instruments and control to aid operators and give performance data, an unusual thing in marine practice
5. Superheat automatically controlled to within ±10 F aids turbine economy
6. Feedwater treatment carefully supervised from shore by water treatment consultant; daily water analysis on board ship maintains treatment control
7. Condenser and cooler tube maintenance and how it is reduced by a deaerating tank
8. How losses are reduced in the lubricating oil system
9. Preventive maintenance of electrical equipment after each voyage and how it improves economy

These are the principal factors in reducing losses discussed in detail in this paper, which was presented in a symposium on Reducing Losses in Power Generation and Consumption sponsored by the Power and Fuels Divisions of the ASME at the annual meeting in New York in November, 1945. Another paper of this symposium, Functions of an Efficiency Bureau, by John R. Michel, was published in the February, 1946, issue; it dealt with methods of reducing losses employed by a large utility organization.

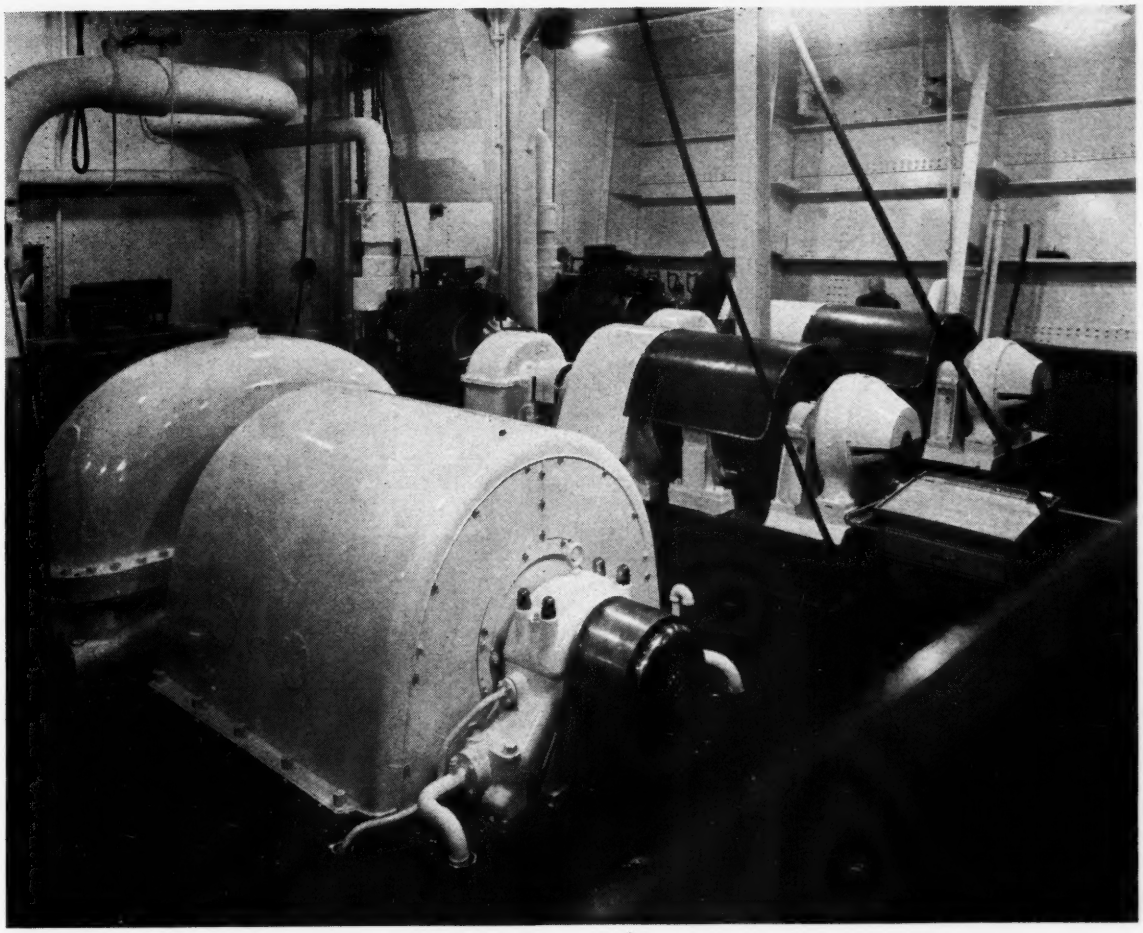


Fig. 1. General view of turbine room on one of vessels, showing main turbine, taking steam at 650 psi, 920 F, driving 2300-v, 60-cycle, 3600-rpm generator supplying motor driving propeller. Auxiliary sets in right background

temperature steam on all auxiliaries, even including the small feedwater pump turbines. These, by the way, are the only steam-driven auxiliaries outside of the auxiliary turbine generators that we have aboard our ships.

In order to get the maximum economy out of this power plant, we have used standard frequency generators for main propulsion. When the ship is being propelled at sea at full speed, the propelling motor is turning 90 rpm and the turbine generator generating 2300 v at 60 cycles and 3600 rpm. Now, the first step in economy in operation we will show you right here.

Saving Auxiliary Steam

With the water rate on the main turbine generator approximately 1/3 that of the water rate on the turbine-driven auxiliary generators, we saw an opportunity to save a lot of auxiliary steam and this is how it is done: When the generator is running at 60 cycles, we run the ac generators on the auxiliary sets as motors and motorize the auxiliary sets to provide excitation for the main generator. Such motorizing is done manually when the power plant is running at 60 cycles. If the engineer in the engine room should get a maneuvering bell, which would require him to reduce the speed of the main turbine generator in order to reduce the speed of the main propelling motor, and if the main generator gets down to 53 cycles, steam is automatically cut over to the auxiliary turbine generators and they carry on as independent units.

This, of course, very rarely happens outside of pilot waters and inasmuch as the ship's time is spent 95 per cent at sea, it is easy to see how much saving of fuel is accomplished by running the auxiliaries motorized as described. Of course under those conditions the 2300 v generated by the main generator is transformed to 440 v for the auxiliaries.

How Air Soot Blowers Save Fuel

Because these power plants are high-temperature, high-pressure, and great care is taken in the water preparation for feedwater (described later), we use compressed air for blowing soot from the boilers and air preheaters instead of steam, which is a waste of fresh water that must be carried and evaporated.

Here again we introduced another economy by being the first to use what is now known as the air puff system, in which an electrical distributor actuates one soot blowing head after the other so that the soot really never has much time to accumulate, rather than waiting and blowing soot once a watch, in which you only get a certain percentage removed with a consequent loss of efficiency by the fly ash that is left behind. We even go so far as to use an air whistle, instead of a steam whistle. While the steam whistle is not used so often, yet when it is blown automatically in a fog it is amazing to find out how much steam and again how much distilled water is consumed. This may sound to many as attempting to get the squeal, but again, we say, all these things add up.

We have gone to some extremes to see that our engineers are properly instructed and aided in operating the plant as it was intended to operate. This is sometimes very difficult with

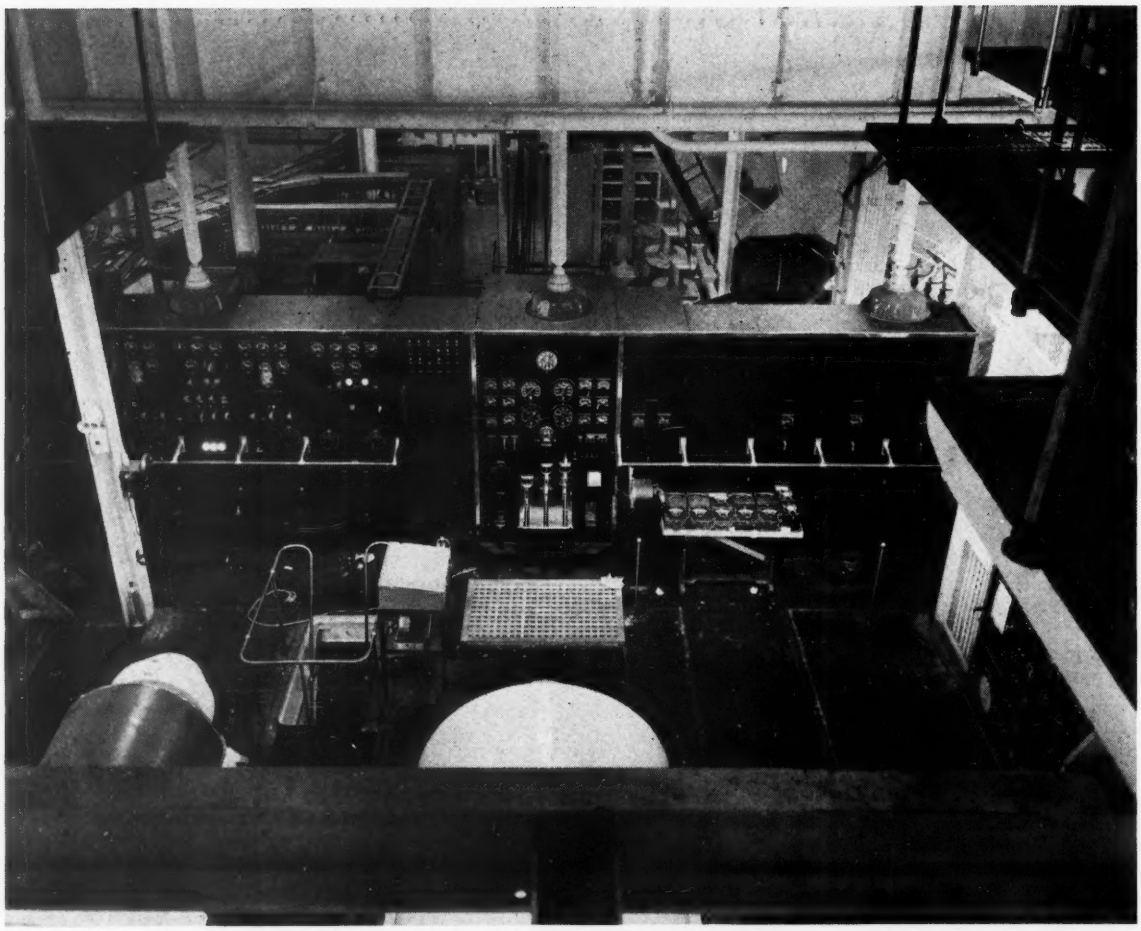


Fig. 2. View of main switchboard from above main turbine-generator set

old hands whose habits learned in running old fashioned wasteful plants are hard to eradicate. We have found it often better to train green men who didn't have too much to unlearn.

How Automatic Control Reduces Losses

We have now had vessels of this type at sea over eight years with automatic control, which consists of all the boiler control instruments with automatic regulation for combustion, air flow, steam flow and steam temperature. There is for each boiler a recording steam-flow meter, temperature recorders for steam, and air before and after combustion. We also use a recording meter on the main turbine steam flow showing pressure, flow, and temperature. This latter instrument is of extreme importance when interpreted properly, which will be described later.

One novel thing about these power plants is the automatic control of superheat which has meant very great economy because we could hold the superheat within 10 degrees regardless of the load. This is done by an outside regulating valve, which regulates the flow through a desuperheater coil in order to temper the steam. This is particularly effective under maneuvering where the flywheel effect of heat in the furnace would tend to make the superheat greatly overrun. By using this control, we can run our design temperature on our turbines at all times without fear of overheating and with the subsequent gain in economy.

How Flow Meter Aids Turbine Economy

The flow meter on the main turbine is of very particular importance because, with an oil-relay governor and no hand wheels on the turbine where the admission valves operate entirely automatically, without a flowmeter on the main turbine it is almost impossible to regulate the governor under sea conditions. In other words, when the vessel is coming in and out of the sea and the load is changing, the governor often becomes isochronous and this hunting which ensues causes an overlap of the opening of steam valves not necessary for load. The result is a change in turbine speed and, of course, a resulting steam flow and loss of economy. By watching the breadth of the line on the flow meter chart to the main turbine, the governor action is instantly seen. The governor then can be regulated to be broad or narrow, according to the seaway and the load changing conditions, and thus operate the turbine at the maximum economy for the conditions at which the ship must operate in a given seaway.

Instrument Charts and Log Analyzed

Charts from all these instruments are turned in for examination at the end of each voyage, together with the engineer's log, which enables a close check to be kept on operation. This is done by the port engineer's office which is part of the Operating Department.

At unstated intervals the Engineering Department makes engineering audits of these charts and checks with the logs and reports to the port engineer of the Operating Department what is observed as to the efficiency of operation as against design.

Water Treatment

Daily water analysis is made aboard ship and the treatment accorded as required, in accordance with instructions issued by outside consulting engineers who control water treatment. A recording salinometer keeps a continuous record of the salt water content of the boiler feedwater, evaporator, hot well, and so on.

From each out port samples are sent to the consulting engineer in charge of water treatment and based on their analysis treatment changes

are ordered. This has been a very satisfactory operation and there seems to be a distinct advantage in having an outside company control the treatment, both because they are an independent observer, and because they offer protection in the case of trouble.

Reducing Condenser Tube Replacement

One of the biggest problems in connection with this sea-going equipment is the maintenance of condenser and cooler tubes aboard ship where salt water cooling is used. Replacement of such tubes has been a major source of upkeep on all ships. In an effort to battle this perennial source of trouble, we equipped our first turbine-electric ship, put in service eight years ago, with a condenser water deaerating tank built into a part of the engine room double-bottom space.

While the writer does not claim that this tank takes out all of the entrained air from the water before it is pumped into the condenser, it evidently takes out enough to protect the condenser tubes, for none have had to be renewed in the nearly eight years since the first of these ships has been in service. The generator and motor air coolers are also fed with water from the main circulating system and they have had no tube renewals. These coolers are fitted with admiralty metal tubes.

It might be interesting to point out here that some of our most modern ships have had condenser tube life in the Pacific of as low as 78 days, and cooler tubes we believe as low as 60 days, due to active oxygen impingement of air entrained in the circulating water. This is a very definite point of economy and one that has never been given too much consideration.

We have described this feature in some detail as it is unique and contrasts sharply with the experience of the U. S. Maritime Commission on tankers of similar design, built later, without this deaerating device and on which condenser tube trouble has been extremely prevalent, and on which there have been many failures due to flooded propelling motors from cooler tube failures. This all has to do with the economy of operation of the ship because the economy of the power plant is in its ability to deliver at all times its rated capacity.

Lubrication the Heart of Continuous Operation

Another point that we would like to draw to your attention is the lubricating oil system on a modern turbine-electric power plant, often much neglected. Inasmuch as your lubricating oil system is the heart of your continuous operation, it is important that it be safe-guarded.

On our ships we have two attached lubricating oil pumps submerged in the oil sump; one supplying oil for the oil relay governor only, and the other supplying oil for forced feed to the main bearings of the turbine generator. In addition, we have an automatically-controlled, turbine-driven lubricating oil pump with the pump also submerged in the sump tank which cuts in automatically at a certain pre-determined low oil pressure; and with such equipment we have never had a bearing failure and no measurable wear.

This is in contrast to the many ships sailing with this type power plant having motor-driven lubricating oil pumps and gravity feed. With these there have been many cases in which, when the motor-driven pumps failed, the overflow gravity tank was unfortunately empty resulting in loss of bearings, grabbing of the main turbine, preventing her future economical operation without re-blading, generator damage, etc.

Reducing Electrical Losses

We have left until the last any discussion of the electrical machinery and its maintenance. We particularly want to bring this to the attention of the Society members because the writer, personally, believes that we leave this too much to other societies, not wanting to consider it with our problems because it happens to be electrical.

The proper maintenance of electrical machinery aboard ship is one of preventive maintenance and we have accomplished that by a study of electric drive ships, which we have operated for practically 25 years. This experience with electrically-propelled ships has given us a superior knowledge, which we apply to the electrical auxiliaries which are common to all ships.

Each time one of our vessels comes in to port, all the main generators, main propelling motors, etc., are tested with a megger. If the insulation resistance reads less than 100,000 ohms ,the ship is not allowed to go to sea until an investigation is made which will indicate the source of trouble, and steps taken to remove the low resistance.

By keeping careful records of these megger readings and plotting them, we are able then to see trends which would show deterioration and anticipate trouble. The result is that we are able to operate these vessels without an electrician in the crew and thus all connections are left as they were originally designed and successful operation ensues.

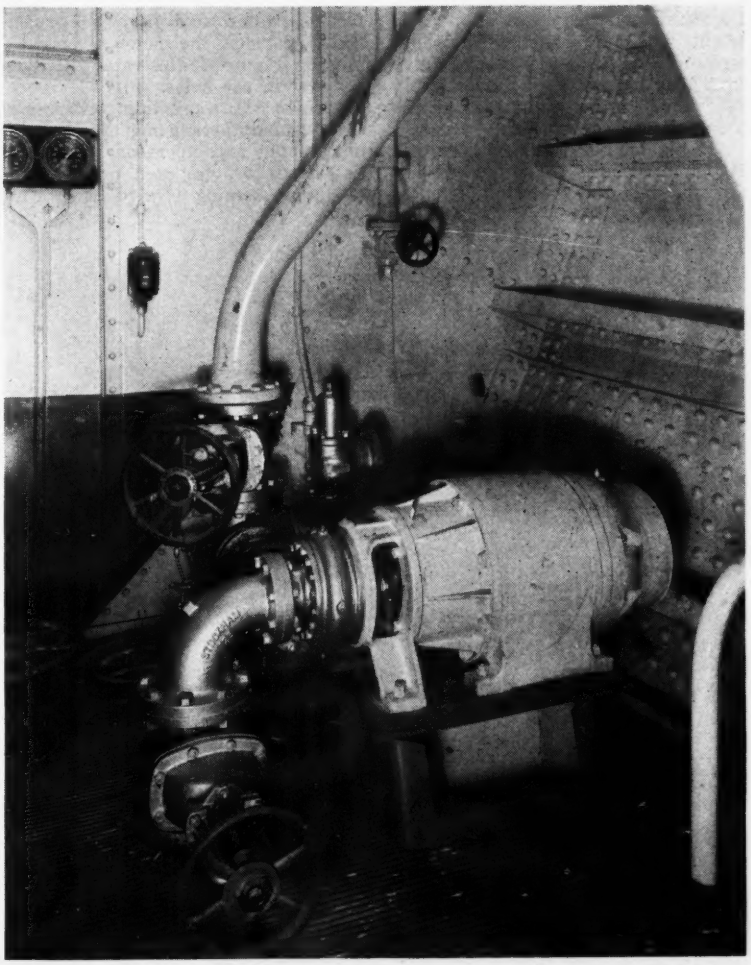


Fig. 3. Installation of a typical pump on one of the vessels referred to. Note valving and other installation details

A Compact, Accurate Manometer for High Differentials

The apparatus described here was developed to provide a simple yet accurate and compact means of testing and establishing the accuracy of high head flow meters. It has been used successfully for a number of years for the full scale calibation of meters with maximum heads of nearly 30 feet of water

By LESTER J. ROWELL

Engineer, Station Efficiency, State Line Station
Chicago District Electric Generating Corp.

IT IS SOMETIMES exceedingly difficult to establish the accuracy of a high head flow meter. Anyone who has had the experience of calibrating such a meter in the field by erecting a manometer twenty feet or more in height will appreciate the troubles encountered. Such a procedure may have been successful, but it certainly left much to be desired from the standpoint of convenience.

The manometer described here (see Fig. 1) overcomes the above difficulties and has the desirable qualities of being compact, accurate, rugged and portable. The minimum headroom requirement is seven feet. It is capable of measuring any differential head up to the equivalent of fifty feet of water, and may be placed above or below the meter to be calibrated. Figure 6 illustrates the manometer in use below a meter where headroom is at a premium, and shows a convenient arrangement of meter, manometer and operator. Differential heads are imposed or adjusted by simply turning a valve, as shown; and all readings are taken by only one man in one location. There is no ladder to climb; no water to handle; no calling or signaling between operators. The two wheeled truck gives the instrument portability and a firm foundation on which to stand. The glass columns for water and mercury may be easily removed if so desired when the instrument is not in use. Neither column is long enough to give rise to any serious temperature gradient.

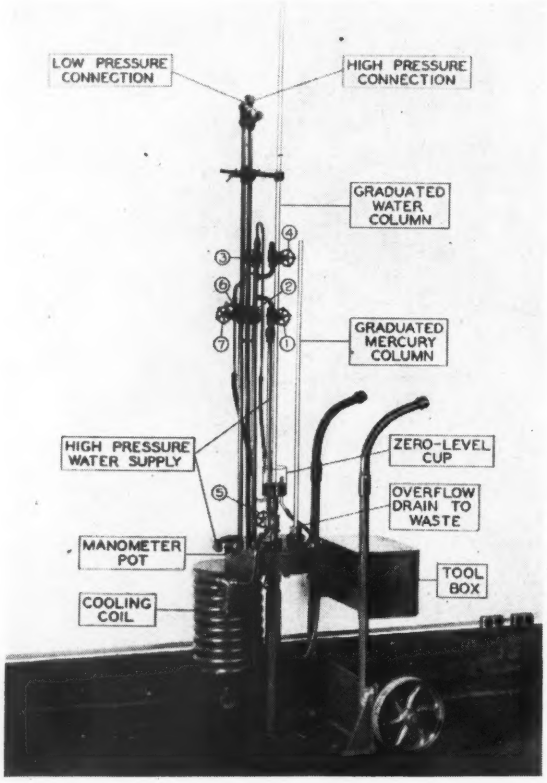


Fig. 1. This photograph shows the complete manometer assembled on a two-wheeled truck for portability. As shown, it even includes a tool box for wrenches and fittings with which to make connections

This manometer is particularly suitable for wet calibrations although it may be adapted to dry ones also. The instrument provides an individual water column for each meter connection and measures an easily imposed differential head by the difference in levels in each. Singularly, however, the level in the low pressure leg does not change, a feature which makes it possible to make all head measurements from a definite and fixed reference point. Figures 2 to 5 illustrate how this is accomplished. The low pressure connection from the meter terminates in what is called the zero-level cup which is concentric with a graduated water column connected to the high pressure connection. With zero differential head imposed on the meter, the levels in the cup and column are the same. For any other condition, the imposed head is the difference in levels. By etching the water column in inches and tenths and adjusting the zero to coincide with level A-A, differential heads up to 53 inches can be measured directly and quickly within ± 0.02 inches. Differential heads beyond the range of the water column are measured on a mercury column etched in inches, tenths and twentieths and read to ± 0.01 inches.

The operation is simple once the hookup is understood. Connect the high and low pressure connections on the manometer to the corresponding

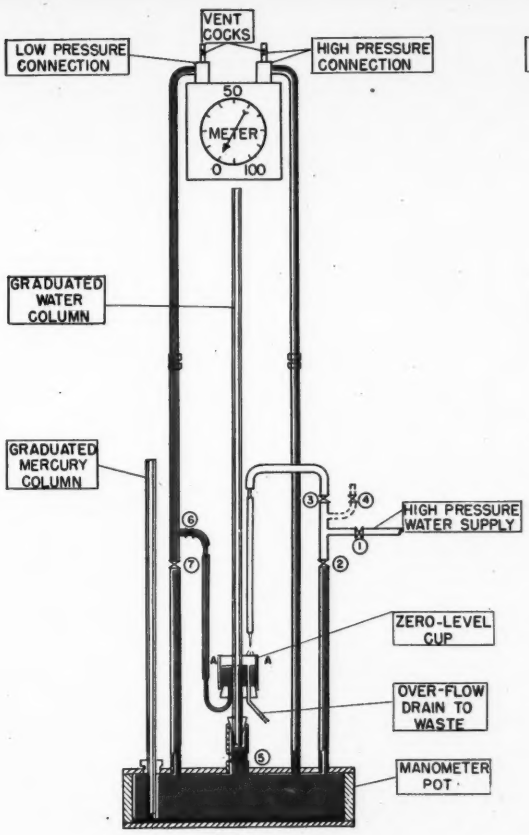


FIG. 2

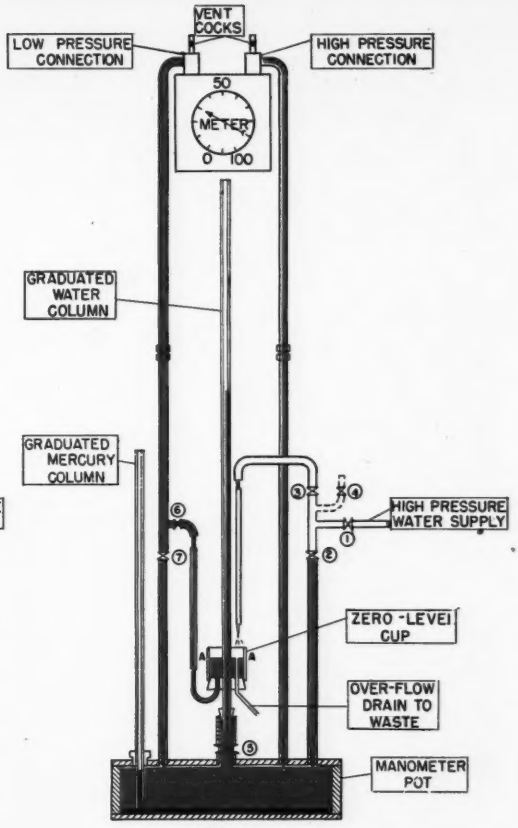


FIG. 3

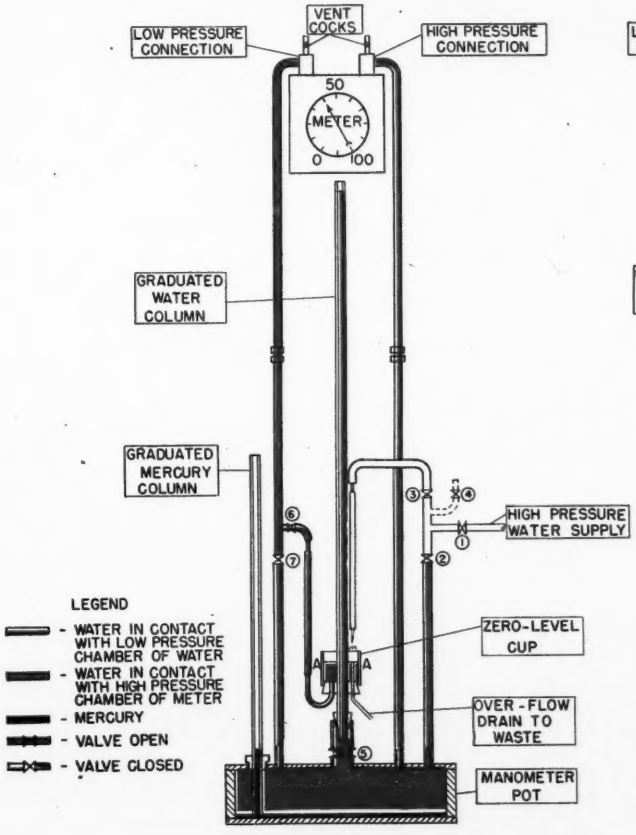


FIG. 4

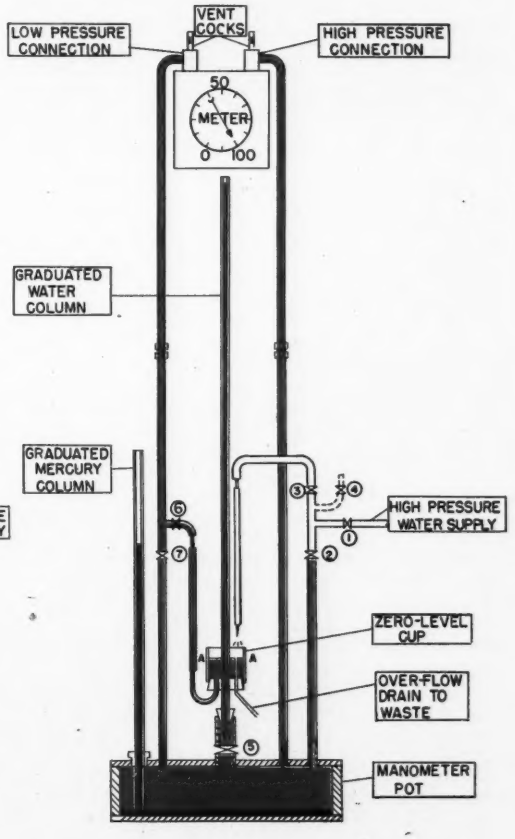


FIG. 5

Fig. 6. The manometer in use where headroom is at a premium

connections on the meter to be calibrated and open the meter vent cocks. Purge all lines and manometer pot thoroughly by means of the high pressure water supply. During this operation all valves are open except 6. Water will overflow the end of the water column and run down into the zero-level cup. To end the purge, close the vent cocks at the top of the lines running to the meter; close valve 2 and open valve 6. The water level in the graduated water column will now come to rest at the level maintained by the height of the overflow drain in the zero-level cup. This level is maintained constant by a small stream of water regulated by valve 3 and flowing at all times into the overflow cup. Since the meter is now equalized through valve 7, it should read zero. With the closing of valve 7, it is ready for calibration. (See Fig. 2). Crack valve 2 to build up a head in the graduated water column. When a desired head has been reached, shut valve 2 again and take readings. (See Fig. 3). Repeat the process until the head has risen to the top of the graduated water column. (See Fig. 4).

By now the level in the graduated mercury column will have appeared above the pot so that it can be read. Note the corresponding readings on the graduated columns and the meter, then close valve 5. The transition from the water column to the mercury column has now been made with no error, and the calibration may be continued to higher heads in the same manner as before. (See Fig. 5).

Heads may be reduced by cracking valve 7. When the mercury head is again down to the point where the transition from water to mercury was made, open valve 5 and continue with the water column.

Valve 4 is used, when necessary, to make connection with another meter which may be linked mechanically with the one under calibration. This makes it possible to increase the head on the adjoining meter along with the one under calibration, thereby preventing any binding action in the linkage. The cooling coil shown in the photographs cools boiler feedwater which is used as the high pressure water source. Boiler feedwater is desirable because it furnishes a deaerated supply, thus eliminating any possible trouble from air bubbles either in the meter or lines.

This manometer has been used successfully for a number of years for full scale calibrations of meters with maximum heads of nearly 30 feet of water. It is conveniently operated by one man and shortens the overall time of a complete meter calibration by many hours and in some cases days. It is common for one man to complete the "as found" and "as left" calibrations of a 330 inch meter, together with necessary adjustments and cleaning, in eight hours. A calibration consists of twenty readings exclusive of the "zero"—ten ascending and ten descending, at intervals equal to 10 per cent of the maximum flow. Some calibrations which are well nigh impossible without an instrument of this kind are now performed with ease.

A NEW TYPE of lamp has recently been developed by the Western Union Telegraph Company of New York. This new light source is said to be ten times as brilliant as that from an incandescent lamp and only a little less bright than that of the hottest carbon arc. The light is emitted from a spot of molten zirconium oxide, only 3/1000 of an inch in diameter.

The tiny quantity of oxide is held on one of two metal electrodes inside a glass bulb that has been filled with an inert gas such as argon and bombardment with ion raises the oxide to the melting temperature. Constantly renewing itself during operation the glowing electrode lasts for hundreds of hours, operates quietly, burns in any position, and makes possible a rugged lamp requiring no attention or adjustment. As described before a meeting of the Optical Society of America in Cleveland one time, this new light source is said to have particular advantage in light projecting optical equipment. Since all of the lamps rays emerge from what is practically one point, it is a means for attaining high definition and clarity in projecting motion pictures and in making photographic enlargements up to 20 times the size of the original film. The brilliant white lights high photographic activity reduces exposure time and is well adapted to color film processes. It should also extend the usefulness of the optical microscope for the concentrated beam will permit higher orders of magnification and open the way to new fields of research.

Because 50 per cent of the light from the zirconium point arc will be effective in a motion picture projector, Western Union engineers say that the lamp will produce from 5 to 10 times as much brilliancy on the screen and last 100 times as long as a tungsten projection lamp of similar rating.

100 Million Volt Betatron Makes Most Powerful X-rays

New electron accelerator constructed at Schenectady produces X-rays equivalent to 100,000,000-volts. This unit is supplied with a current at 1000 amp at 24,000 volts from the largest single bank of capacitors ever assembled. The machine is to be used in experimental work in the field of nuclear research

REMOVAL of wartime restrictions has made possible the revelation of details concerning the 100,000,000 volt "betatron" or electron accelerator construced at the General Electric Research Laboratory at Schenectady. According to Dr. C. G. Suits, G-E vice president and director of the Research Laboratory, the new machine gives out X-rays of a power never previously approached.

"These X-rays will penetrate a thickness of metal considerably greater than the rays from our 2,000,000 volt industrial X-ray unit," Dr. Suits said. "But even more exciting to us are the possibilities that with the 100,000,000 volt electron stream that produces X-rays of the same energy we can produce other interesting forms of radiation. In fact, we have now arrived at the stage where we can generate in the laboratory radiations which formerly were available only in the cosmic rays, and we are just passing the borders of an entirely new field of atomic research."

Dr. E. E. Charlton, head of the X-ray section of the Laboratory and his associate, W. F. Westendorp, have had immediate charge of the betatron's construction. They are authors of a paper giving details of the new machine, published in the October number of the Journal of Applied Physics.

Located in a special building with concrete walls three feet thick, as a protection from the dangerous rays given off, the principal part of the betatron is a huge electromagnet, made of 130 tons of laminated silicon steel. It is 9 feet high, 6 feet wide and 15 feet long. In a rectangular opening passing through the magnet from front to back are the pole faces, 76 inches in diameter, surrounded by large coils of insulated 1-inch copper conductor. As electricity at 24,000 volts surges through these coils from a bank of condensers in an upstairs room, the magnet is energized, the intense magnetic field being concentrated in the horizontal space between the pole-faces.

Here is the heart of the machine—a doughnut-shaped vacuum tube of glass. The doughnut has an over-all diameter of 74 inches while the tube itself, of elliptical cross section, measures inside 8 inches horizontally and nearly 5 inches vertically. It is made of 16 sectors of molded and tempered pyrex glass, cemented together. The inner surface of this tube had to be made electrically conducting, so that it would not accumulate a charge that would upset the paths of the electrons within. This was accomplished by sandblasting the inner surfaces and then silvering them.

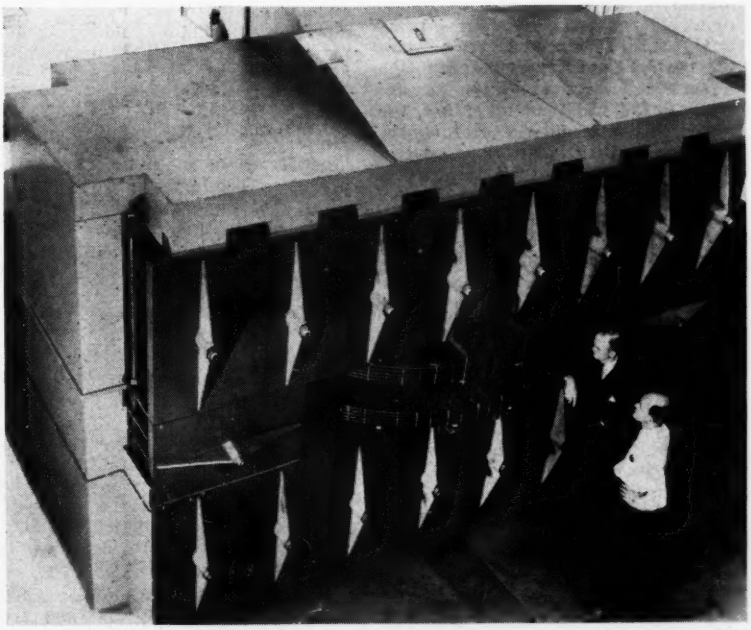
Projecting into the doughnut at one point is an electron gun, consisting of a heated filament from which electrons are boiled off, to be given an initial impulse of several thousands volts to start them in their orbits inside the doughnut. The magnetic field holds them in a fixed circular orbit as they gain speed and energy on successive revolutions, gaining about 400 electron volts each trip.

The machine operates on ordinary 60-cycle alternating current. Acceleration of the electrons is confined to the first quarter of each cycle, lasting 1/240th of a second, during which the current goes from zero to its maximum in one direction. Then it goes back to zero, before building up in the opposite direction. If the electrons were allowed to remain in the tube during the second quarter cycle they would be slowed down again, so they are removed before this happens.

Just as the end of the quarter cycle is reached, a pulse of current passes through two smaller auxiliary coils on the pole faces. This causes the electrons to spiral away from their orbit and to hit a tungsten target which they previously missed. This causes the generation of X-rays, which emerge from the doughnut in a beam which is 2 degrees in diameter when the machine is operated at full power.

It may, however, be operated at a lower power, as the pulse may be applied at any time during the first quarter cycle. If, for example, it is

(Continued on page 65)



Massive size of the betatron is indicated by this view showing the new 100,000,000 volt machine with Dr. E. E. Charlton, left, head of the X-ray section of the G. E. Research Laboratory, and W. F. Westendorp. These two scientists were responsible for the design and construction of the machine

Application of Electric Motors to Power Station Auxiliaries

By A. E. BEARDMORE

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Part III. Motors for fan and pump drives . . . Requirements of forced and induced draft fans . . . motors commonly used for fan drives in power stations . . . Boiler feed and condensate pump drives . . . Points to check in the installation of pump drives . . . Special axial clearance in bearings . . . Circulating water pump drives . . . Misclearance in bearings . . . Circulating water pump drives

ANY NORMAL POWER STATION fan requires only a low starting torque to break it away from rest, and the starting torque of a normal starting torque squirrel-cage motor is more than ample to break the fan away from rest if the motor is started on full voltage, as is the usual procedure in power stations. Motors for driving power station draft fans should have at least 200 per cent maximum running torque in order to enable them to drive the fans at practically full load and full speed through serious voltage disturbances. If, without injury to the motor, it can drive the fan at practically full load for at least one minute with 70 per cent voltage at the motor terminals and with the fan control set for full load operation, the motor will be accepted as suitable for most installations. If it is necessary that the motor drive the fan for periods longer than one minute, or operate on voltages lower than 70 per cent, it will be necessary to have a breakdown torque greater than 200 per cent, and a careful check of requirements should be made.

A motor should not be operated right at the maximum torque point when running on either full or reduced voltage for over a minute and, if possible, the time of operation at the maximum torque point should be kept well under a minute because the slip at maximum torque is high, resulting in rapid rotor heating. Preferably, any normal starting torque, normal starting current, squirrel-cage motor should not be operated at loads greater than 85 per cent of maximum torque, even for periods as short as one minute, because above this value the slip and rotor heating increase rapidly. The slip at maximum torque is approximately twice that at 85 per cent of maximum torque.

Either squirrel-cage or wound-rotor motors having a maximum torque greater than 200 per cent may be obtained if desired. However, in the case of squirrel-cage motors, the higher maximum torque is obtained at the expense of higher starting current, and since there is a tendency in some quarters to limit starting current, good practice seems to favor using motors having not less than 200 per cent maximum running torque for power station auxiliary drive.

If wound-rotor motors are used, the starting current is limited by the secondary resistance, and motors having a higher maximum running torque may be obtained without appreciably affecting the starting current.

In general, drip-proof, 40 C rise motors are used for power station fan drives, although in some cases other types of motors are required because of the high ambient temperatures. The motors driving draft fans in a power station are more likely to be located in a high ambient than any other motors of appreciable size in the station. Because of this fact particular attention should be given to determining the ambient temperatures in which these motors will have to operate and the loads which they will be required to carry, so that if the total temperature of the motor (ambient plus rise) exceeds 90 C, either class B insulation can be used or pipe-ventilated motors provided with cool air, or one of the other combinations mentioned previously for high ambient temperatures can be used.

The most common type of drives used for fans in power stations are:

1. Single speed, squirrel-cage induction motors driving the fans at constant speed with vane or damper control of the draft. (Fig. 8).

2. Two-speed squirrel-cage induction motors or 2-single speed, squirrel-cage induction motors with van or damper control of the draft.

3. Wound-rotor induction motors with secondary control providing speed regulation for the fan. Where only a few points of speed control are used, a damper or vane control may be used as a vernier to give a refinement of the draft control. If a secondary control is arranged to provide a large number of steps of control over a wide range, such as may be provided with a liquid rheostat, no additional vane control may be necessary.

4. Single-speed squirred-cage induction motors with magnetic or hydraulic couplings to provide variable fan speed.

5. Synchronous motors operating at constant speed with magnetic or hydraulic couplings to provide variable fan speed .

6. Direct-current motors using a combination of field and armature control to provide variable speed for the fan drive.

Where single-speed, squirrel-cage induction motors are used for driving fans at constant speed and the draft control is by means of vanes or damper, a simple, normal starting torque squirrel-cage induction motor started on full voltage is usually used, since in most cases the standard squirrel-cage induction motor will be capable of accelerating the inertia of all except the very heavy induced draft fans. In case the fans are of unusually heavy construction, it may be desirable to advise the motor manufacturer of the inertia of the fan which the motor is to drive so that the proper motor is obtained for the application.

Where two-speed squirrel-cage induction motors are used with vane or

damper control, the motor is usually, a two-winding, two-speed motor such as a 1200/900-rpm or a 900/720-rpm motor, as the usual reduction in speed desired is less than 2:1. Therefore, single winding motors cannot be used, since with a single winding the two speeds must have a ratio of 2:1. Additional draft variation is provided by means of vane or damper control the same as in the case of single-speed motors.

Where wound-rotor induction motor are used for fan drives, the speed of the motor is varied in order to provide the fan speed necessary to meet draft requirements. Secondary control of the wound-rotor motor provides a low starting current for the motor and also permits operating over the necessary speed range. If a wide speed range with a large number of operating points or stepless control is desired, liquid rheostats may be used in the secondary of the wound-rotor motor, permitting operating over the range from full speed down to 30 per cent of full speed, the liquid rheostat being operated directly by the automatic combustion control system used in the power station.

Where single-speed, squirrel-cage motors connected to magnetic or hydraulic couplings are used for fan drive, the motor operates at constant speed and the speed of the fan is controlled by the coupling. The coupling is usually provided with its own bearings so that a squirrel-cage motor of normal design may be used. The motor is connected to one-half of the coupling through a normal type of flexible coupling.

If a synchronous motor is used with a magnetic or a hydraulic coupling for fan drive, it is necessary that either the synchronous motor be capable of synchronizing the total WR^2 and load of coupling and fan, or that a control be used to unload the coupling. This is accomplished by removing the excitation in the case of a magnetic coupling, or removing the oil in the case of a hydraulic coupling, at any time that the motor pulls out of step, and to again load up the motor by re-applying excitation to the coupling of the magnetic type, or returning oil to the hydraulic coupling after the motor has been re-synchronized. It is desirable and practically necessary that this should be done automatically. This is because in the case of power failure of a momentary nature, or a sufficient drop in voltage to permit the synchronous motor to pull out of step, it is necessary that the motor re-accelerate and re-synchronize as quickly as power returns, and that this be done without any attention on the part of the station operator.

When separate pulverizer exhauster fans are used, the motors for driving these fans are frequently subjected to the same ambient conditions as the pulverizer motors. Consequently, motors having the same type of enclosure as provided for the pulverizer motors may be required. In general, the ambient conditions will determine the enclosure required for pulverizer exhauster motors. These motors are usually normal starting torque, normal starting current, single-speed, squirrel-cage induction motors having at least 200 per cent maximum running torque.

Boiler Feed and Condensate Pump Drives

Boiler feed pumps and condensate or boiler feed booster pumps are usually true centrifugal pumps having very similar torque requirements. These pumps usually require a low break-away torque, probably less than 20 per cent of full load torque. Under conditions where the pump can exert the maximum torque requirement on the motor, the torque required to drive the pump will vary approximately as the square of the speed reaching full load torque by the time the motor is up to speed. In most actual installations, the conditions are such that the pump torque during starting is less than that indicated above. Usually the WR^2 of pumps of this type is relatively small and is rarely a factor where the driving motor is started on full voltage.

Nearly all of the boiler feed pump drives for high pressure boilers now operate 1800 or 3600 rpm, and it is common practice to start the driving motors on full voltage. Since the starting torque of these pumps is relatively low and the inertia of the driven loads is seldom a factor where the motor is connected directly to the pump, a normal starting torque, squirrel-cage induction motor designed for full voltage starting and having at least 200 per cent maximum running torque will have the necessary torque requirements for pump drive. If, for some reason, it is desirable to start the motor at reduced voltage, then the speed torque curve of the motor when operating at reduced voltage should be checked against the speed torque curve of the pumps under starting conditions. This is to insure that the motor always has ample torque for starting and accelerating the pump up to speed. This particular point is emphasized because 3600-rpm motors have a speed torque curve as shown previously under motor characteristic curves. It will be noted that the torque developed below approximately 80 per cent speed is not very high and care must be used in selecting the reduced starting voltage, because if too low a starting voltage is used the torque curve of the motor may be lowered to such an extent that the motor will not accelerate the pump up to speed.

The same comments apply regarding motors for driving condensate pumps or booster boiler feed pumps, although these motors are usually lower speed units and the torque curve of the motor usually has more margin over the pump curve, and the application is not so critical. However, if reduced voltage is used, the motor torque curve at reduced voltage should be checked against the pump torque curve in order to make sure that the motor has ample torque margin to accelerate the pump up to speed.

The most common types of drives for boiler feed pumps and booster or condensate pumps are:

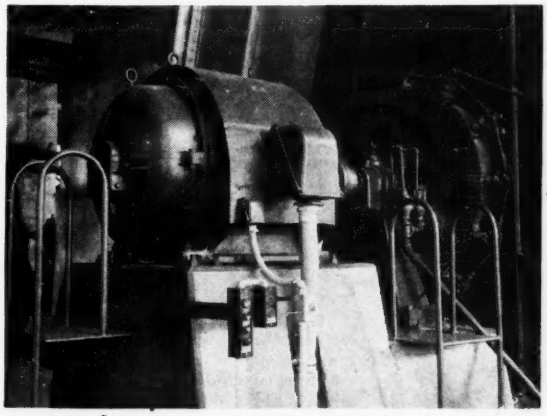

Fig. 8. A 500-hp, 1200-rpm, 2200-v, 3-phase, 60-cycle, drip-proof, 40 C sleeve-bearing squirrel-cage induction motor driving a forced draft fan having vane control

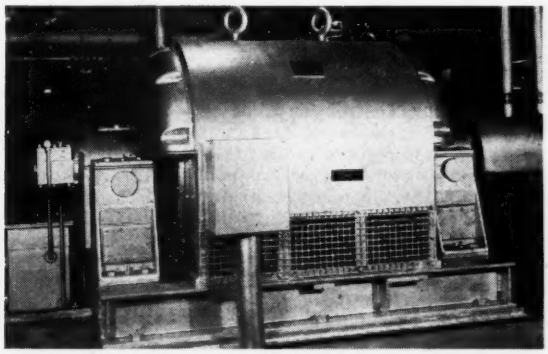

Fig. 9. An 800-hp, 3600-rpm, 2300-v, 3-phase, 60-cycle, drip-proof, 40 C rise squirrel-cage induction motor with pressure lubricated sleeve bearings, direct-connected to a 3600-rpm centrifugal boiler feed pump

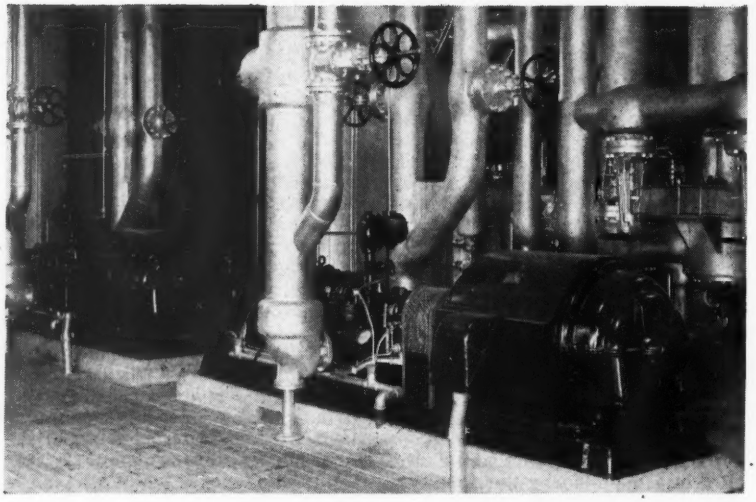

Fig. 10. Two 350-hp, 3600-rpm, 2400-v, 3-phase, 60-cycle, 40 C rise splash-proof, sleeve bearing, squirrel-cage induction motors direct connected to 3600-rpm centrifugal boiler feed pumps

1. A constant-speed squirrel-cage motor usually operating at 1800 or 3600 rpm driving a boiler feed pump which will meet the maximum water requirements. This arrangement requires that the output of the pump be throttled to meet boiler requirements.

2. Two boiler feed pumps connected in series, one driven at constant speed by a squirrel-cage motor and the second driven by a variable-speed, wound-rotor motor. The usual combination is a large high-pressure pump which develops a pressure practically equal to the boiler pressure driven at constant speed by a 3600-rpm squirrel-cage motor and a variable-speed, low-pressure pump driven by a medium-speed, wound-rotor motor. The speed of the wound-rotor motor will be changed to meet the water requirements of the boiler. In a few cases, the constant-speed and the variable-speed pumps are the same size, and then both pumps usually operate at a lower speed, such as 1800 or 1200 rpm.

3. A constant-speed, 3600-rpm squirrel-cage motor drive for the boiler feed pump with a medium-speed squirrel-cage motor and a hydraulic or magnetic-coupling supplying variable speed to the booster or condensate pumps.

4. A 3600-rpm wound-rotor motor with secondary control providing various speeds for the boiler feed pump. With the development of large 3600 rpm wound-rotor motors for boiler feed pump drive, one large high-speed wound-rotor motor is used to drive the boiler feed pump over the entire speed range necessary to provide the required amount of water for the boiler. At this writing, these motors are available in sizes up to and including 1500 hp at 3600 rpm, and motors of this size are now in successful operation. With this arrangement, the speed control to meet the water requirements for the boiler is provided by means of a secondary drum controller and resistance. Usually the speed variation is not very wide, probably a total of 20 per cent, and a drum controller operated by the boiler water level control system regulates the amount of resistance in the secondary and thereby the speed of the pump and the amount of water supplied to the boiler. If more steps of speed control are required, a liquid rheostat may be substituted for the drum controller as a means of providing an unlimited number of operating speeds.

5. In a few cases, a squirrel-cage induction motor with a hydraulic or magnetic coupling is used to provide variable speed and a step-up gear is used to drive the boiler feed pump at the necessary speed.

The normal starting torque squirrel-cage induction motors referred to previously will have suitable torque characteristics for full voltage starting on any of the combinations mentioned above. Where wound-rotor motors are used, the torque developed by the motor at start depends upon the amount of resistance inserted in the secondary circuit, and the torque characteristics of the wound rotor motors are more than ample for the pump requirements.

Points to Check

The factors that should be checked carefully in making an application are ambient temperature and dirt and moisture conditions. Usually the boiler feed pump motors are not located in an excessively high ambient temperature, so a 40 C motor designed for operating in a 40 C ambient is usually used. There may be exceptional cases, however, where a higher ambient will be encountered. In such cases, a motor slightly larger than normally required may be used, or a motor rated 30 C rise, which is essentially the same thing, i.e., an oversize motor, or a normal 40 C rise motor with class B insulation may be used. In a few instances, it may be desirable to use motors arranged for ventilation from an outside source. Such pipe-ventilated motors may be arranged to bring in cool ventilating air to the motors, and, if there is no objection the air may be discharged into the room. If discharging the air into the room is objectionable, the motor may be arranged for pipe connections to carry the air elsewhere. Where it is not convenient to use pipe-ventilated motors, totally-enclosed motors with heat exchangers located either under the motor or built into the side of the motor frame may be used.

For the majority of boiler feed pump applications, a dripproof 40 C motor (Fig. 9) may be used. These motors are protected against dripping from above and are rated 40 C rise over a 40 C ambient. Thus they provide all the overload capacities normally required for a properly motored boiler feed pump drive, since the design of the pump is usually such that under any operating conditions the motor cannot be overloaded more than a few per cent. If ambient temperatures are high, these motors may be provided with class B insulation, which will make them suitable for operating in ambients up to 60 C. If conditions are unusual, splash-proof motors (Fig. 10) may be used.

If ambient temperature conditions are bad, or other conditions make it desirable, base-ventilated motors with surface air coolers, or motors with air cooler units built into the motor frame (see Fig. 1*) may be used. In the larger sizes, base-ventilated motors (Fig. 11) with surface air coolers are sometimes used to keep the warm air from the motor from being discharged into the room, since in some cases the amount of heat given off by the motor makes the temperature of the motor room too high. Another advantage of the use of a base-ventilated motor with surface air coolers is to reduce the noise level of the room. This is particularly true of very large high-speed motors which necessarily make some noise because of the large amount of ventilating air that is passed through the motor at high velocity. Where surface air coolers or heat exchangers are used, the motor is then provided with an enclosed ventilating system similar to the turbine driven generator, and the motor winding is kept clean and dry. The air is recirculated through the motor and practically an ideal condition is provided for the winding, reducing the amount of maintenance required by the motor.

In cases where the boiler feed pump motors are large ones, the condensate is circulated through the heat exchangers in order to pick up the heat lost in the motor and take it back into the system.

Where wound-rotor motors are required, they may be provided with the necessary protection, such as drip-

*Power Plant Engineering, February, 1946, page 73.

proof, splashproof, or enclosed, ventilated features. Consequently, either squirrel-cage or wound-rotor motors are available with the necessary protection for successful operation in any of the ambient conditions normally encountered.

Special Axial Clearance in Bearings

In the class of 1800 or 3600-rpm motors, 500-hp and larger for boiler feed pump drives, it is desirable that the motors should be provided with ½-in. end play in the motor bearing and that flexible couplings, which will limit the actual endwire movement of the rotor to 3/16 in., be used.

With this arrangement the motor, flexible couplings, and pump are assembled with the bearing clearances so adjusted that when the pump is operating at normal speed and normal temperature, the motor will be operating at practically its normal magnetic center. The additional clearance in the motor bearing prevents the thrust collar on the motor shaft from touching the end of the motor bearing at either end of the motor at any time, either during starting or running conditions. This permits the thrust bearings in the pump to position the entire rotating unit and eliminates any possibility of damage to the motor thrust bearing.

Circulating Water Pump Drives

Circulating pumps require a relatively low torque to break them away from rest, probably in the order of 20 per cent or less of normal full load torque, and the torque required by the pump increases approximately as the square of the speed up to full load torque at full speed. Since the starting torque required by these pumps is relatively low and the inertia of the driven load is seldom a factor where the motor is connected directly to the pump, a normal starting torque, squirrel-cage induction motor designed for full voltage starting and having at least 200 per cent maximum running torque will have the necessary torque requirements for pump drive. Circulating pumps are usually run at constant speed and as a rule are not located in a high ambient temperature. Therefore, 40 C rise motors suitable for operating in a 40 C ambient are generally used.

Either vertical or horizontal pumps and motors may be used, depending on the arrangement which fits in best with the design of the station. In any case, the motors should be dripproof as a minimum requirement, and if conditions are bad splashproof motors may be necessary, although usually dripproof motors are sufficiently protected to meet normal operating conditions. Where vertical motors and pumps are required, the motors may be provided with thrust bearings to carry the combined hydraulic and dead weight thrust loads of the pump.

Miscellaneous Drives

Motors for other miscellaneous pump drives, such as hot well pumps, deaerator pumps, boiler make-up water storage pumps, heater drain pumps, make-up water treatment pumps, and ash sluice pumps, are usually all normal starting torque, squirrel-cage induction motors capable of developing at least 200 per cent maximum running torque. Generally, these drives all operate at constant speed, but if speed control is wanted wound-rotor motors may be used for driving these pumps.

In new power stations the ambient conditions as a rule are relatively good for probably 90 per cent of these pump drives, and dripproof 40 C motors may be used for most locations. There may be a few instances where the motors are subjected to splashing water and consequently splashproof motors are required. In the relatively few cases where dirt conditions are extremely bad, enclosed fan cooled motors may be required.

(THE END).

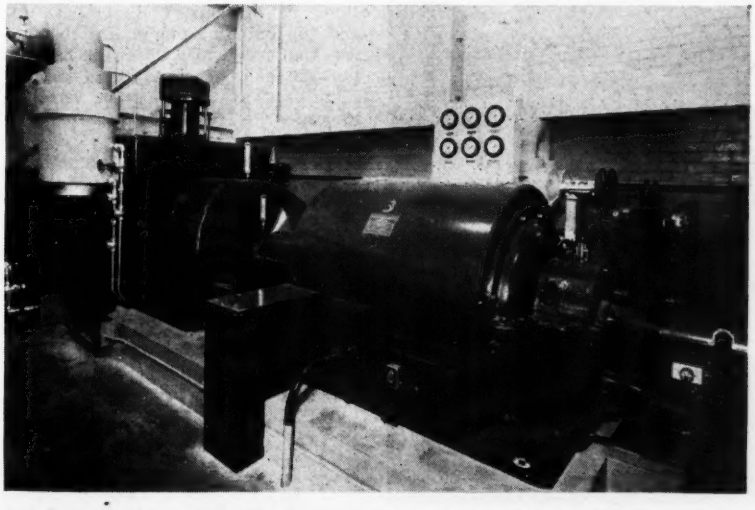

Fig. 11. One of the nine similar base-ventilated, 1300-hp, 3600-rpm, 40 C rise, squirrel-cage induction motors used in connection with turbines for boiler feed and condensate pump drive

Correction. Part I Application of Electric Motors to Power Station Auxiliaries

OUR ATTENTION has been directed to two errors in Part I of Mr. Beardmore's article presented in the February issue. These errors occur in the tabulation on page 75 of that issue. Line 12 of this table should read "440-550 volts, ½ hp to 1000 hp at any speed." Line 13 of the same table should read "220 volts, ½ hp to 200 hp at any speed."

Betatron

(Continued from page 61)

done when they have made only 125,000 instead of the full 250,000 revolutions, they will only have energies of 50,000,000 electron volts. Or they may be taken out at any other stage so the device can produce X-rays from about 2,000,000 up to 100,000,000 volts, though at the lower energies the production is rather feeble.

Control of the betatron is from a neighboring room. An elaborate series of switches and dials enable the operators to tell what is happening, since they cannot enter the machine room, or have doors to it open, when it is in operation.

Considerable energy is dissipated by the betatron while in operation, and to keep it cool the slabs of steel from which the magnet is made are separated so that air for cooling may be drawn through them.

The big machine was built under the direct supervision of Mr. Westendorp and Dr. Charlton. It was placed in operation in the summer of 1943.

A smaller betatron, completed in 1941 and operating at 20,000,000 volts, was also built in the Laboratory in collaboration with Dr. Donald W. Kerst, who was on leave from the University of Illinois. Immediately upon its completion this machine was loaned to the University where Dr. Kerst has been conducting researches with it.

In 1939, with some assistance from the General Electric X-ray Corporation, Dr. Kerst had built a small table-sized betatron at the University of Illinois. It was capable of energies of 2,300,000 volts and his paper describing it was the first report of the realization of a successful device of this character.

The possibility of using a magnetic field in this way to impart high velocity to electrons was discussed in 1928 by a German, R. Wideroe, and in 1929 by an Englishman, E. T. S. Walton. In 1937 a U. S. Patent was issued to Max Steenbeck, of the Siemens Schuchert Works in Germany on a device embodying the principles set forth by Wideroe and Walton.

Chemical Removal of Scale from Fire Tube Boilers

By

C. H. GROOM

E. C. HARDY

Engineers, Dowell Inc.

Scale removal by chemical methods has progressed to the point where it is an accepted practice—Techniques require correctly blended acids and inhibitors—Specific solvents are required for cleaning various metal surfaces and types of scale—Heat losses due to boiler scale accumulation are given by authors—Case studies of results secured by chemically cleansing various types of fire tube boilers are presented—Recommended procedure to be followed in using chemical descaling method is suggested—Bibliography of pertinent articles

USE OF CHEMICALS for the removal of scales and sludges from industrial equipment, whether deposited by water, steam or some other method has become an accepted practice because progressive operating engineers recognize the numerous advantages of this thorough, safe and rapid method.

Problems which previously retarded chemical scale removal operations have been solved so that today service companies with correctly blended solvents, proper treating techniques, specially designed treating equipment and experienced engineers are readily available at numerous strategically located points.

During the few years that the method of removing scales and sludges has been in use, rapid progress has been made so that size and complexity of the unit to be cleaned, the metals comprising it and the composition of the scale or sludge deposit offers no problem to the service company with proper equipment, materials and experienced engineers.

Among the most commonly used equipment that becomes scaled-over are fire tube boilers. These boilers, including the locomotive, upright and Scotch marine types are used in refineries, oil fields, dairies, laundries, small and medium size power plants and other kinds of plants. Low cost, simplicity of operation and design are factors that make these boilers popular.

Presence of an insulating blanket of scale or sludge in a boiler reduces its rating, as efficiency is governed by the amount of heat applied and the proportion of that heat transferred to the water. Any scale or sludge that is present will increase fuel consumption and reduced output.

The effect of various thicknesses and types of scales on heat transfer has been studied.[1]

Some of the data developed during this study are shown in Table I.

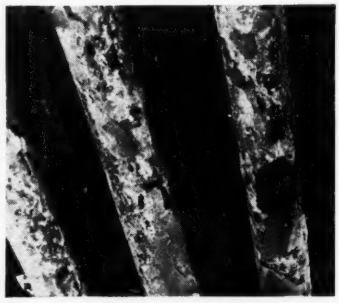

Fig. 1. Fire tube boilers are often operated with excessively scaled tubes such as indicated here

Insulating deposits most commonly found are composed of one or more of the following minerals: calcium carbonate, calcium sulphate, magnesium silicate, hydroxy-apatite, and magnesium hydroxide. Less frequently encountered minerals are magnesium carbonate, xonolite, analcite and sodium sulphate.

Scales and sludges such as those mentioned above have been known to form even under the best operating conditions. Feedwater treatments are of great value and perform an important service, but changes in water source and composition, variations in pressure and temperature and the human element are the factors that frequently upset the balance that results in precipitation of troublesome deposits that must be removed in order to restore operating efficiency.

A large number of different scale and sludge deposits have been analyzed by methods described in the literature[2]. These samples from fire tube boilers were identified and cataloged by X-ray diffraction patterns

Table I—Loss of Heat Due to Scale

Thickness of Scale, inches	Loss of Heat, % Soft Carbonate	Hard Carbonate	Hard Sulphate
1/50	3.5	5.2	3.0
1/32	7.0	8.3	6.0
1/25	8.0	9.9	9.0
1/20	10.0	11.2	11.0
1/16	12.5	12.6	12.6
1/11	15.0	14.3	14.3
1/9	...	16.0	16.0

Fig. 2. With proper solvent, equipment, and application the average fire tube boiler, such as shown here, can be descaled and on the line in 8 to 12 hours' time

and by chemical analysis. In Table II are shown data on boiler use, type of boiler and scale analyses. A study of these data and the physical properties of the scale provided information required to select the proper solvent combination, concentration treatment temperature and technique of application for each boiler. All of the chemical treatments for the removal of the deposits were made by a service company using specially designed equipment as illustrated in Figure 3. In the paragraphs below are given in brief form some of the pertinent data on the scale and sludge removal treatments.

An 80 hp Freeman boiler had to be either cleaned or shut down. As this was the only boiler for heat and process steam, downtime was limited. Within 8 hr the boiler was completely free of scale, had passed inspection, and was back in service.

The only boiler operated by a small packing company was a 150 hp hrt. Scale deposits were building up and it was becoming impossible to carry enough pressure to operate. The boiler was completely descaled with solvent in less than 24 hr. After descaling, no trouble was encountered in carrying the load and coal consumption dropped.

A baking company, in adding to its plant, was advised to install a second boiler, as the 150 hp hrt boiler in the old plant was considered inadequate. The tubes were coated with a ⅜ in. layer of 50 per cent calcium carbonate and 50 per cent magnesium silicate. The boiler was completely descaled on a Saturday afternoon. Another boiler was unnecessary!

A Crane boiler in an automotive factory was practically filled with calcium carbonate scale requiring almost constant firing. The boiler was taken over the following 5 p.m. shift change, completely descaled, and was back in service at 9 p.m.

Two 110 hp locomotive type boilers were scaled badly with calcium carbonate and magnesium silicate causing tube failures. Both of these boilers were filled with solvent which removed the scale in four hours time.

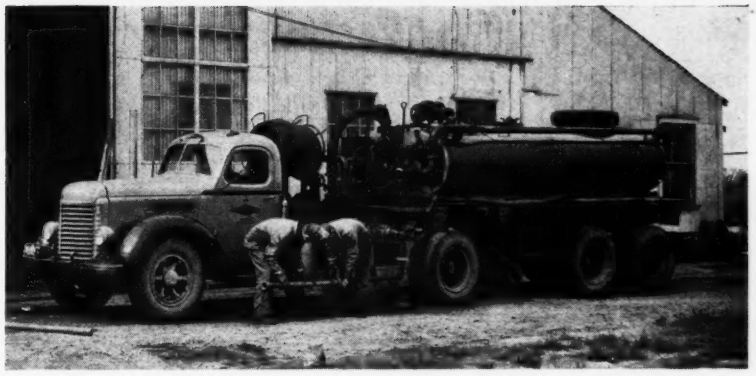

Fig. 3. Modern, especially designed treating equipment is used to transport and pump chemicals into customers equipment

A 305 hp Scotch marine boiler was used for heat and process steam in a refinery. After 2 yr of service a scale deposit nearly ½ in. thick had materially reduced operating efficiency. Complete retubing had been recommended but this was not a desirable solution to the problem as the required downtime could not be afforded. The boiler was descaled chemically on a Sunday at a cost ⅔ less than for new tubes.

Among the larger fire tube boilers cleaned with scale solvents were two 1000 hp waste heat boilers in a steel mill. They were so full of scale that one could not see beyond the first tubes. The scale was approximately 75 per cent hydroxy apatite and 25 per cent magnesium silicate. Each boiler held 6300 gal. Both were descaled over a weekend shut down. Analyses of the used solvents indicated approximately three tons of scale were removed from each boiler.

Knowledge of the pertinent solvents and their application is a prime requisite. This can only be attained through intelligent laboratory research. The acid type solvents used can be dangerous to personnel and property if improperly used. It is essential that the material used give adequate protection to the boiler metals under conditions encountered in the cleaning operation.

Identification of the scale deposits is necessary to choose a proper solvent as the treatment cannot be prescribed until the problems have been identified.

Good engineering in applying the solvent is as necessary to good results as the solvent composition itself. Special equipment for transporting, mixing, and handling the solvent is required.

All of the above can be handled by chemical and engineering research but the problems are such that few concerns have the time or personnel to study all phases of chemical cleaning, and prefer to turn the problems over to service companies specializing in the work. In this manner the operator is assured that skilled personnel are working on his equipment using the best methods and equipment available.

The authors believe that with the proper solvent and application in a dirty boiler, fuel savings of from ¼ to ⅓ can be expected. The recommended procedure to follow is to obtain samples of the scale, and through laboratory research choose the best solvent and method of application. Where the operator does not wish to spend time in research or has not the facilities and experienced engineers and specially designed treating equipment, the problem should be turned over to a suitable service company.

Table II—Boiler Use and Examples of Scale Analyses

Operator	Type of Boiler	% Calcium Carbonate $CaCO_3$	% Calcium Sulphate $CaSO_4$	% Magnesium Silicate $MgSi_4O_7.2H_2O$	% Magnesium Hydroxide $Mg(OH)_2$	% Hydroxy Apatite $Ca_{10}(OH)_2(PO_4)_6$	Miscellaneous
Small Chemical Plant	HRT	25	10	15	50	..	...
Dairy	HRT	75	..	25	..	..	...
Packing Company[1]	150 HP HRT	65	..	..	..	..	(*)
Ship	Scotch Marine	25	60	15	..	..	...
Crane[1]	Upright	95	5	..	..	..	...
Ordnance	150 HP HRT	20	..	..	..	80	...
Hospital	50 HP HRT	35	35	..	10	20	...
Refinery[1]	305 HP Scotch Marine	100	..	..	..	..	...
Steel Mill	Locomotive	10	40	10	40	..	...
Greenhouse	22 HP HRT	..	50	..	50	..	...
Machine Shop	HRT	40	..	..	25	35	...
Dairy	114 HP HRT	60	..	25	15	..	...
Brewery	300 HP Scotch Marine	50	..	50	..	..	...
Paper Manufacturer	60 HP HRT	60	..	40	..	..	...
Refinery[1]	110 HP Locomotive	60	..	40	..	..	...
Manufacturer[1]	80 HP Freeman	80	20	..	..	..	...
Bakery[1]	150 HP HRT	50	..	50	..	..	...
Steel Mill[1]	Waste Heat	..	.	5	..	75	...

[1] Discussed in article.
*35 Magnesium Carbonate $MgCO_3$.

Bibliography

[1] Michigan Department of Health Engineering Bulletin No. 15, 1939

[2] "Scale Removal by Chemical Means", by M. E. Brines, Power Plant Engineering, Vol. 44, May, 1940, Pg. 47-49

[3] "Chemical Removal of Scale from Compressor Engineer", by Guy F. Williams, Oil and Gas Journal, Vol. 38, May 2, 1940, Pg. 34-35

[4] "Chemical Removal of Scale from Refinery Equipment", by L. W. Lee, Refiner and Natural Gasoline Manufacturer, Vol. 19, June, 1940, Pg. 106-108

[5] "X-Ray Method of Identifying Types of Scale-Forming Deposits", by P. E. Fitzgerald, The Petroleum Engineer, Vol II, April, 1940, Pg. 161-162 and 164

[6] "Chemical Removal of Scale from Heat-Exchange Equipment", by F. N. Alquist, C. H. Groom, and G. F. Williams, Transactions of the A.S.M.E., Vol. 65, No. 7, October, 1943, Pg. 719-722

An Electronic Exciter for Large Generators

Details of the design and construction of an electronic exciter for a 65,000 kw turbo-generator at Springdale Station of the West Penn Power Company. This description was presented as a paper before the Winter Meeting of the American Institute of Electrical Engineers held in New York, January, 1946

By W. R. Farley and C. R. Marcum

Westinghouse Electric Corporation
East Pittsburgh, Pa.

AN ELECTRONIC EXCITER for a 65,000 kw turbo-generator has been built recently for installation at the Springfield plant of the West Penn Power Company. This exciter uses ignitron tubes and is completely enclosed in steel cubicles.

A simplified circuit diagram of this electronic exciter is shown in Fig. 1. The delta, 6-phase star rectifier transformer is energized from the plant auxiliary power supply. As will be noted, the unit comprises three groups of two ignitrons, each group connected through a 2-pole anode breaker to diametrically opposite phases of the transformer. The common cathode of each group is connected through a knife switch to the positive d-c terminal. The neutral of the transformer bank is connected to the negative d-c terminal.

Each pole of the anode breaker is equipped with a reverse current trip attachment providing for automatic tripping on ignitron arc-back. The opening of a breaker removes two ignitrons from service avoiding transformer saturation and providing the most nearly balanced conditions during partial capacity operation. With one anode breaker open, the four remaining ignitrons can supply sufficient d-c voltage for full load field excitation. With but two ignitrons in service, the rectifier can provide no load field excitation continuously and full load field excitation momentarily. The rectifier transformer voltage ratio is so selected that with all tubes in service and an auxiliary power voltage as low as 75 per cent of normal, the rectifier can supply the field excitation necessary under fault conditions.

In the event of loss of a-c power on the rectifier with at least one anode breaker closed, the ignitron tubes provide a discharge path for the generator field. If all three anode breakers are open, suitably connected field discharge contacts connect a resistor across the field.

Due to its simplicity and flexibility of control, the anode firing type of excitation circuit is used, as shown in Fig. 2. With the anode breaker closed, the ignitor is connected through the thyratron in series with a resistor and fuse to the anode of the ignitron. If the thyratron is made conductive, while the anode of the ignitron is positive with respect to the cathode, current flows through the ignitor, allowing power current to flow through the ignitron. As the ignitron becomes conductive, it essentially short circuits the excitation circuit. Should the ignitron fail to conduct current for several cycles, the current in the excitation circuit is interrupted by the fuse.

To aid in making the ignitron conductive, an auxiliary anode is used. Since the auxiliary anode is near the cathode, it conducts current easily and draws the arc initiated by the ignitor toward the main anode. As shown in Fig. 3, a small voltage is applied to the auxiliary anode in series with a current limiting resistor. A rectox and bleeder resistor limits the inverse voltage on the auxiliary anode.

If an ignitron fails to conduct current, a misfire relay and an indicator identify the faulty tube. The misfire relay is connected from the neutral of the rectifier transformer to the thyratron plate lead, as shown in Fig. 2. Fuse failure, due to an ignitron misfire, de-energizes the relay. The misfire indicator is a lamp con-

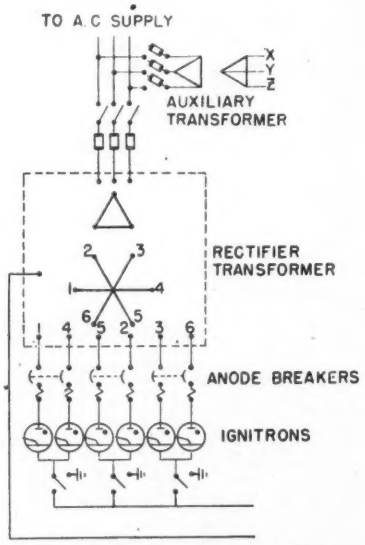

Fig. 1. Simplified circuit diagram of the electronic exciter

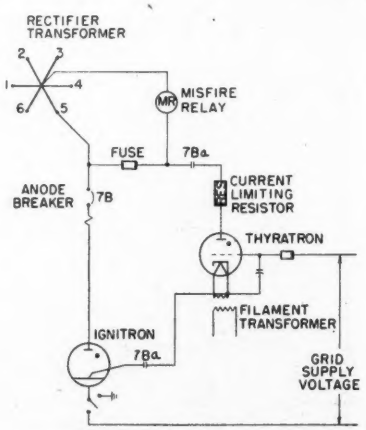

Fig. 2. Anode firing type of ignitron excitation circuit

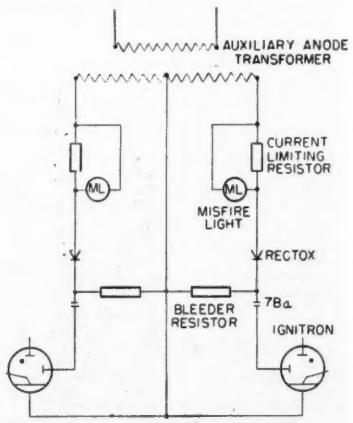

Fig. 3. Ignitron auxiliary anode circuit

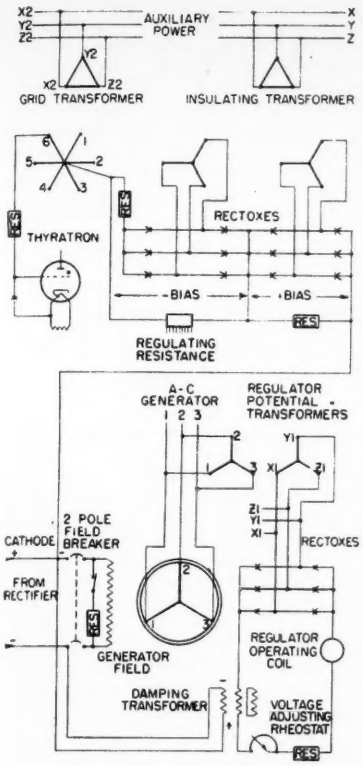

Fig. 4. Generator voltage control circuit

nected across the current limiting resistor in the auxiliary anode circuit. If an ignitron fails to conduct current, there is insufficient voltage drop across the resistor for the energization of the lamp.

The d-c voltage of the rectifier is controlled by varying the points on the a-c anode voltage waves at which the required ignitor impulse currents are applied and the ignitrons start conducting. The ignitor current for each ignitron is provided by a thyratron with its grid connected to one of the six phase, secondary windings of a grid transformer. The neutral of this transformer is connected in series with a d-c bias voltage to the cathode of the rectifier, as indicated in Fig. 4. By varying the value and polarity of the d-c bias voltage superimposed on the a-c voltage, the time at which the ignitron becomes conductive, is controlled.

The d-c grid bias voltage is the algebraic sum of a fixed positive d-c voltage and varying portions of a larger negative d-c voltage. With a positive d-c bias voltage of suitable value, the ignitron may be made conductive as soon as the applied anode voltage becomes sufficiently more positive than the cathode. Under these conditions the d-c voltage of the rectifier is a maximum. As the d-c grid bias voltage is decreased, the thyratron and ignitron are held non-conducting during increasing portions of the cycle, resulting in decreasing rectifier d-c voltage.

The negative d-c voltage component of the grid bias voltage is automatically controlled by a voltage regulator. The regulator consists essentially of an electromagnet whose pull (against that of a spring) is arranged to control the position of a hinged armature, whose movement causes the opening or closing of silver button contacts connected to taps on the regulating resistance. The operating coil of the electromagnet is connected in series with a voltage adjusting rheostat and a damping transformer to a d-c (rectox supplied) voltage corresponding to the average three phase a-c generator voltage. The closing and opening of the button contacts respectively decrease and increase the portion of the regulating resistance in the circuit and thereby the negative d-c voltage component. For example, if the a-c generator voltage momentarily increases above normal, the electromagnet pull overbalances the pull of the spring. Additional button contacts open, increasing the negative d-c voltage component and making the grid bias voltage less positive. The rectifier d-c voltage is thus reduced as necessary to provide the correct a-c generator voltage.

Auxiliary relays, as indicated in Fig. 5, insure that the rectifier equipment is not unintentionally operated with the thyratron filaments at less than normal operating temperatures and provide an emergency power supply for the thyratron filaments and grids permitting temporary operation of the rectifier equipment in event of the failure of the auxiliary power supply. A long time quick reset relay, a short time slow reset relay and an auxiliary latched type relay energize a signal lamp if the thyratron filaments have been energized sufficiently long to have attained normal operating temperature and prevent automatic reclosing of the anode breakers under other conditions. Other auxiliary relays automatically provide an emergency a-c power supply of the proper phasing from the regulator potential transformers for the thyratrons filaments and grids. A failure of power supply to the bias circuit results in the loss of regulator control, the operation of the rectifier at 0 degree bias (one-half of maximum d-c voltage) and the addition of the required corrective KVA load on the generating unit. Failure of power to the heat exchanger results in the loss of water pressure in the rectifier cooling system and subsequently the overheating of the ignitrons.

Anode Breaker Control

The two pole breakers, used in the a-c power circuits to the anodes of the ignitrons, are arranged for simultaneous closing and tripping from a common control switch, as indicated in Fig. 6. When the spring return control switch is momentarily turned to the close position, individual circuits are completed for the energization of the control contactors for all breakers which are open (unless removed from service for maintenance). The breaker closing operations are completed when the cut-off relays are closed and the breaker closing coils are de-energized. If one or more breakers fail to latch in the closed position or are automatically tripped, a second closing operation may be initiated only after the control switch has first been allowed to return to the off position. Energized red and green indicating lamps identify the closed and open positions of the breakers.

When removing a portion of the rectifier equipment from service for maintenance, the trip button on the rectifier cubicle compartment door is depressed, thereby opening an auxiliary switch contact, tripping the anode breaker, opening its auxiliary maintenance relay and closing its cut-off relay. A keyed lock may then be operated, whose bar holds the trip button depressed and the auxiliary switch contact open, after which the key is removed and used to unlock the compartment door. After completion of the maintenance work and the return of the keyed lock to its normal position, the breaker is closed when the control switch is turned to the close position. (The momentary opening of the control switch off position contact interrupts the short circuit around the operating coil of the auxiliary maintenance relay, followed by the closing of the relay and the opening of the cut-off relay).

The anode breakers are arranged for automatic reclosing when tripped as a result of ignitron arc-backs. If

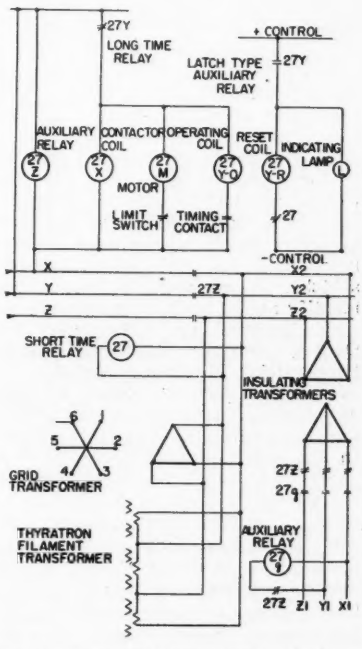

Fig. 5. Thyratron filament and grid power control circuits

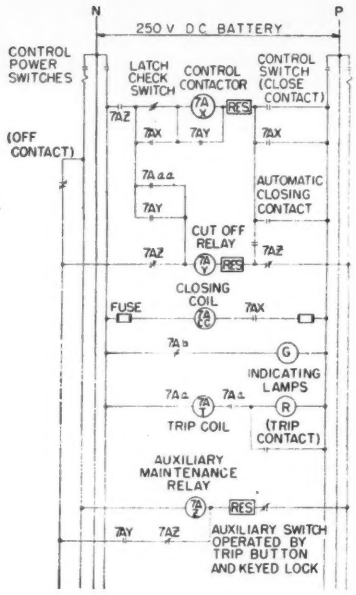

Fig. 6. Anode breaker control circuits

all breakers in service are either simultaneously tripped or sequentially tripped at intervals of a few cycles, a single shot recloser provides for one instantaneous reclosing of the tripped breakers. If, as a result of arc-back tripping, at least one of the anode breakers remains closed, three breaker reclosing operations at timed intervals, the first of which may be instantaneous, are provided by another recloser. The recloser utilized for the breaker reclosing operation is selected by auxiliary relays, whose operating coil circuits are not disturbed when one breaker is manually tripped for maintenance.

Annunciation and Alarm

A visible and audible alarm is provided for abnormal apparatus conditions, for which the rectifier equipment may be continued in service while the difficulty is being corrected or for which the equipment may be temporarily left in service. Annunciator relay targets are operated and an alarm circuit is energized (unless interrupted by the alarm cut-off switch), as indicated in Fig. 7, to identify anode breaker arc-back tripping, ignitron over temperature or misfire, rectifier transformer overtemperature, low water pressure in the rectifier cooling system and loss of thyratron filament and grid power for a predetermined adjustable period. In the event of ignitron misfire or anode breaker tripping on arc-backs, the particular ignitron in trouble is further identified by annunciator targets for the rectifier compartment location and by an inspection of the misfire indicating lamps and the arc-back indicators. As the targets identifying anode breaker tripping due to arc-backs are but momentarily energized, suitable contacts of the recloser auxiliary relays are arranged to energize the alarm circuit until the breakers are either automatically or manually reclosed or the equipment is removed from service.

Mechanical Design

The electronic exciter and its controlling switch-gear is divided into three separately located assemblies to suit the available mounting space and to meet the operating conditions for this installation. One of these assemblies is a two section a-c metal clad cubicle. Equipment in one section of the cubicle includes the load break disconnecting switch, current transformers and disconnecting fuses for the control of the a-c power circuit to the rectified transformer. Apparatus in the other section includes the auxiliary transformer bank and its a-c power circuit disconnecting fuses. Wired glass windows in the front hinged doors of the cubicle sections provide for inspection of the fuses and a mechanical interlock prevents the opening of the door in front of the disconnecting switch, unless the switch is first opened.

The second assembly includes the metal enclosed air insulated rectifier transformer, a three compartment rectifier cubicle, a single section d-c metal enclosed switchboard and the water-to-air heat exchanger. The ignitron and auxiliaries, in as far as practical, are segregated into three portions, each portion being essentially independent of the other. In general, apparatus mounted in the upper front section of the compartment comprises two ignitrons and two thyratons, in the lower front section the common cathode and grounding switch, in the upper rear section the two pole anode breaker and in the lower rear section a suitable portion of the miscellaneous excitation equipment common for the six tube rectifier.

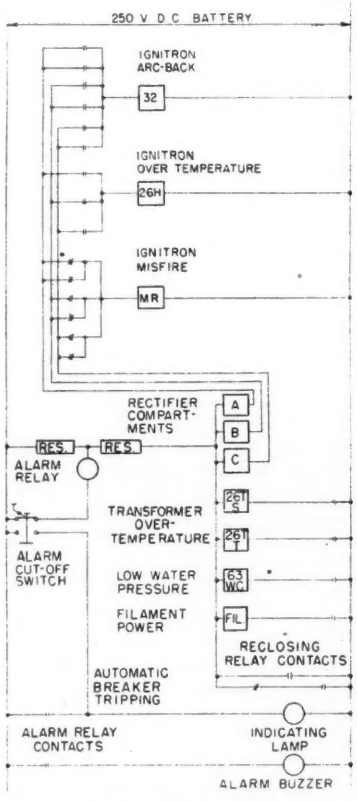

Fig. 7. Signal and alarm circuits

Power-Line Carrier Channels Doubled by Single Sideband

THE SOLUTIONS of many problems are obvious after they have been discovered. Single-handed carrier transmission over power lines has been one example. Its principles were well known twenty years ago, and it has been applied almost exclusively to telephone circuits. But for general use on transmission lines the equipment was too bulky, too complex. Furthermore, the system was not needed. Its greatest single advantage is its economy of frequency width, and only recently has crowding of the frequency spectrum by carrier services become acute. But the problem of how to provide more channels for power-line carrier is now before the engineers of some systems. Designers of Westinghouse carrier apparatus have risen to the demand and have produced a novel single-sideband scheme of the requisite simplicity.

The conventional single-sideband system has been to generate a carrier frequency and to modulate that frequency with the signal to be transmitted. The result was the carrier frequency and the two sideband frequencies (the carrier plus the signal frequency, and the carrier minus the signal frequency). Then for single-sideband transmission, the carrier and one sideband had to be eliminated. This required elaborate filtering.

The new system neatly circumvents these complications by generating only the desired single sideband, creating nothing that must be eliminated later. The crux of the scheme is to use two sets of small dry-type rectifiers and some phase-shifting impedances all connected in such a way that only one sideband of frequencies appears in the output.

In addition to having the effect of doubling the frequency spectrum available for power-line carrier (sometimes the gain is more than two to one) the new single-sideband carrier provides a gain in signal-to-noise ratio of nine decibles. The single-sideband system can be added to modern Westinghouse amplitude-modulated equipments or a-m systems can be installed with the thought of adding the sideband equipment later when more channels for carrier are needed.

To Improve Combustion, Let's Improve the Coal

Development of activated coal promises new approach to an old problem . . . Test data presented to show effects of activating coal on speed of ignition, burning rate, coke formation, elimination of clinker and other burning characteristics . . . New thinking in coal technology a challenge

By **Irwin R. Hoffman** *Fuel Engineer, Central Coal Co., Inc.*

AS OUR ATOMIC scientists have so aptly stated it, combustion is a self-propagating chain reaction. The lighting of a fire releases heat which ignites neighboring fuel and this in turn releases more heat to ignite more fuel. In the combustion of coal this process is accelerated if the fuel is of a high order and receives an ample supply of oxygen; it is retarded with lower grade coal and inadequate mixing of air and fuel. Other retarding factors are poor construction of the fuel bed and inherent unfavorable burning characteristics.

Present Approach

Obviously, this discussion is not aimed at superior coals. It is intended to show how medium and low grade coals may conceivably acquire greatly accelerated igniting and burning rates. Up to now all discussions for raising the efficiency of combustion followed a familiar pattern. The approved line of attack to win this objective employed these tactics:

1. Selection of a good seam or mine; 2. Superior preparation; 3. Blending, to obtain favorable burning characteristics; 4. Co-ordination between fuel and facilities; 5. Improved design of furnaces and fuel burning equipment.

New Approach—Activated Coal

Thus through selection, preparation, blending and firing, attention has been concentrated on results obtainable from the burning of coal in practically its original state. A moth-eaten apologetic gag once widely employed—that coal is not a manufactured product because it comes out of the ground may soon be discarded. The new approach to raising the efficiency of combustion may well be improvement of coal itself.

The new process for enriching and activating coal to higher accomplishment is an actual, if presently uneconomic, realization. The method is simple and an interesting analogy may be drawn from the common match. A stick of wood is partially coated with inflammable materials. On being ignited, this material speeds up the ignition and burning rate of the match-stick. Coal particles behave in a similar manner when coated with inflammable materials, but for full utilization these materials must be added in such a way that they become an integral part of the coal and they must not burn away before the coal particle itself is fully oxidized. For economic efficiency, such materials must be low in cost and applicable in a thoroughly practicable manner, and these are the problems which must be solved before commercial distribution may be realized.

Tests with Activated Coal

Small experimental batches of activated coal have been tested. The results in several cases were startling. In one demonstration, an admixture of activated coal with anthracite rice containing higher than normal ash of low fusion temperature completely changed the character of the fuel bed. Previously incapable of maintaining a satisfactory combustion rate, the rice coal, after admixture, exhibited a far more active fuel bed and easily permitted combustion rates far higher than the untreated coal. Where a pressure of 85 psi could not be attained operating two boilers, the same coal after addition of 10 per cent activated fuel made it possible to raise the pressure easily with the same load.

Observation showed that porosity of the fuel bed was increased due, apparently, to the expanding action of the additive. This naturally permitted better distribution of the air through the fuel. But this was the secondary effect. The primary and more important effect was increased speed of ignition. One of the marked characteristics presented by the activated fuel was the almost complete elimination of clinker. It is believed that the non-clinkering effect is probably due to the improved combustion process rather than to an increase in ash fusion temperature.

It was also amply demonstrated that the activating materials remained in intimate combination with the coal particles throughout the entire burning process, simply through the on and off action of the automatic damper control. Frequently the damper closed, opened and closed again as the steam demand was satisfied while no firing of fuel was attempted. This phenomena was not observed with untreated coal, and would not have been possible if the activating materials had burned away first, leaving the coal itself. Due to the small amount of admixture, it is doubtful if the small increase in heat content of the mixed fuel was an important factor in this demonstration.

Burning tests of the same coal with only a 5 per cent admixture also proved of interest but the load-carrying capacity of the fuel was reduced below that of the 10 per cent admixture, although greatly improved over the untreated coal. Thus it appears that an increase in the admixture of activating fuel increases the fuel value and probably is limited only by economic considerations due to the higher cost of the activator.

Combustion of Activated Pittsburgh Slack

This principle does not apply, however, to an admixture of activated coal with a high-volatile Pittsburgh slack burned in a small underfed stoker. Results of several tests show that more effective combustion was obtained with admixtures of less than 10 per cent. A 60 lb per hr screw-feed stoker was used. Steam was permitted to escape to the atmosphere through an orifice. Operation of the stoker was intermittent, 30 min on and 30 min off by manual control, to simulate unfavorable domestic stoker operation. Water feed was measured and steam pressure registered on a chart. Comparison of performance of untreated and admixed slack was based entirely on the steam chart and evaporation. It will readily be seen why the chart was the main factor.

The first run with straight slack coal produced large coke trees, and

(Continued on page 86)

Editor's Note—The activated coal process referred to here was brought to the author's attention during the war while he was co-ordinator for the New York Metropolitan District under the National Fuel Efficiency Program.

FREE-PISTON
Engines and Compressors

Searching for prime movers of ever higher efficiency to meet post-war conditions, engineers are re-studying the free-piston principle . . . This was utilized in Europe as long ago as 1934 . . . Free-piston machine, compressing air only, had over-all efficiency of over 22 per cent . . . Supplying its hot exhaust gas to a gas turbine driving a generator, combined thermal efficiencies of 40 to 50 per cent are theoretically attainable . . . Machine is simple: no crankshafts nor connecting rods; simple valves and control; little vibration . . . Variable stroke an advantage . . . Principle and operation explained . . . Details of a captured Japanese free-piston compressor of German design

By
Chester R. Earle
Associate Editor,
Power Plant Engineering

FREE-PISTON engines may assume a position of some importance in the near future as components of a new type of power plant. The free-piston machine converts fuel energy into hot exhaust gas and compressed air and can be used either as an air compressor or as a gas generator. In the latter role, it supplies a hot mixture of compressed air and exhaust gas to a gas turbine, which expands the gases completely and delivers shaft power. In this respect, its use is similar to that in which a standard Diesel exhausts to a gas turbine, both being connected to drive the same shaft. When the free-piston compressor is compounded with the gas turbine, however, the compressor does not deliver shaft power but instead replaces the axial turbine ordinarily used with the gas turbine for supplying air.

How the Free-Piston Machine Is Built

The free-piston compressor itself operates on much the same principle as the direct-acting reciprocating steam pump or direct-acting air compressor. The difference is that, in the free-piston compressor, the driving power comes from an internal combustion cylinder containing opposed free pistons, to which are directly attached the air compressor pistons operating in their cylinders. The fundamental principle and construction of the compressor is shown in Fig. 1.

Like the direct-acting reciprocating pump, this compressor has no cranks, crankshafts, connecting rods nor flywheels. Its valves and general construction are simple. The power-producing cylinder operates on the constant high pressure, high tempera-

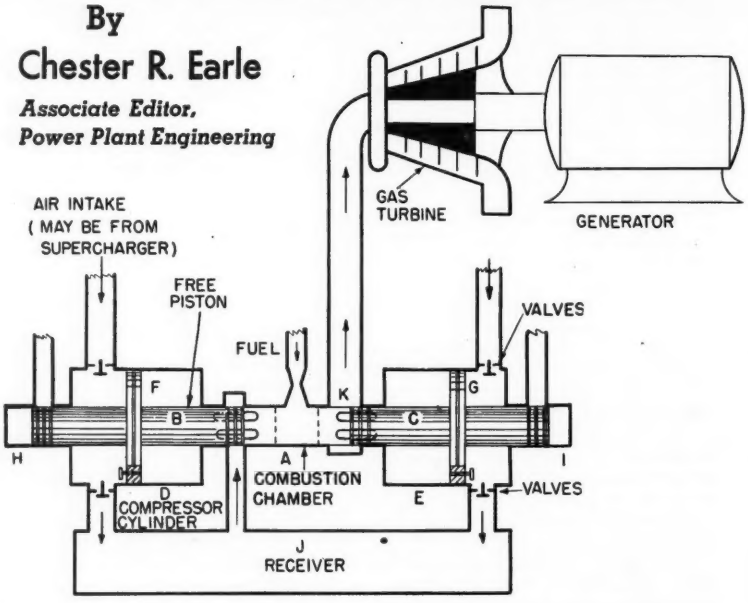

Fig. 1. Schematic diagram of a free-piston compressor—gas turbine cycle. Compressor acts as gas generator for turbine. May be supercharged, as made by Sulzer, from small auxiliary gas turbo-compressor.

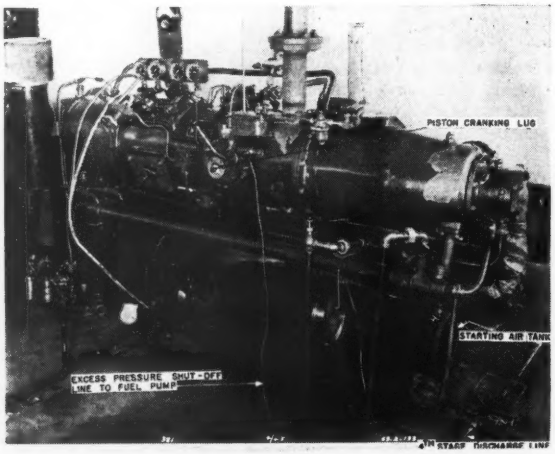

Fig. 2. General view of a free-piston air compressor. Note absence of massive foundation

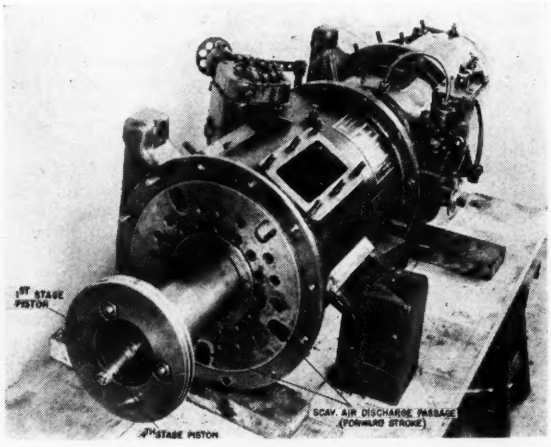

Fig. 3. Compressor of Fig. 2 with outer casing removed, showing 1st and 4th stage pistons

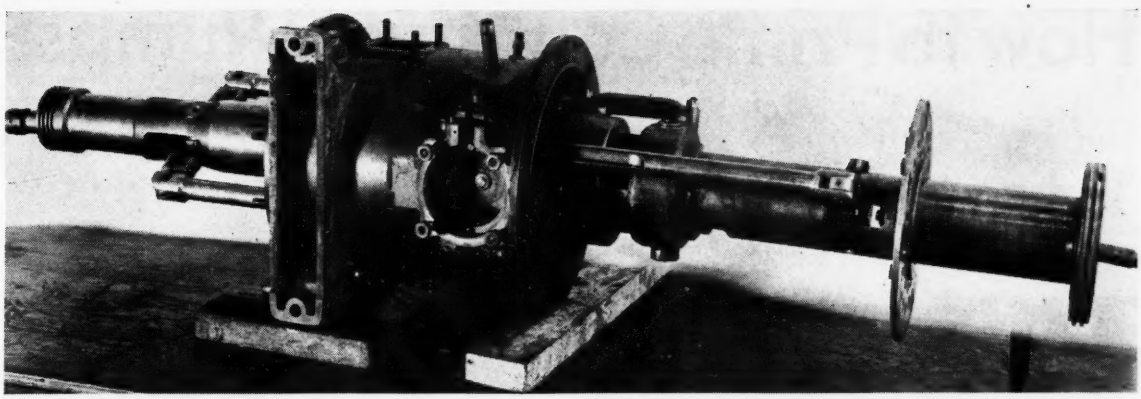

Fig. 4. Compressor of Fig. 2 with cylinders removed to show piston details. This unit develops 3000 psi, has rated capacity (estimated) of 3000 cfh

ture Diesel cycle. The same simplified working fluid is used as in the axial gas turbine. Hence some engineers consider that it embodies the better points of the Diesel and the axial gas turbine.

As shown in Fig. 1, the free-piston compressor consists of a combustion cylinder, air compressor cylinders at each end of it and piston assemblies in the cylinders. Combustion cylinder A contains the opposed pistons B and C, the outer ends of which extend into cylinders D and E carrying compressor pistons F and G. The pistons also extend into cylinders H and I for reasons explained later.

How the Free-Piston Machine Works

Starting with pistons B and C close together as shown by the dotted lines, Fig. 1, fuel is injected into the combustion space (filled with hot compressed air) and ignited. The Diesel explosion forces the pistons apart, driving compressor pistons F and G to compress air in cylinders D and E. This compressed air (heated by compression) passes to receiver J.

As the power pistons reach the end of their strokes, they uncover scavenging ports and compressed air enters the combustion cylinder, scavenges it and exhausts through port K. The combination of exhaust gas and heated compressed air may now flow to the gas turbine or to the nozzle of a power jet. Scavenging air temperature is about 900 F.

To force the pistons back for another Diesel firing cycle, the "bounce" of the compressed air pistons against the air at the ends of the compressor cylinder is used. A practical method of doing this is to extend the pistons into cylinders H and I, where they bounce against compressed air and secure the energy required to produce a return stroke, which will compress air in the combustion cylinder, and, when fuel is again injected at the proper point in the stroke, will cause it to burn in the standard Diesel combustion cycle. These operations will be repeated at a rate of several hundred cycles per minute, depending on engine size.

The fundamental idea shown in Fig. 1 is, of course, subject to refinement in valves, starting mechanism, fuel pumps and other details required to produce a practicable commercial engine.

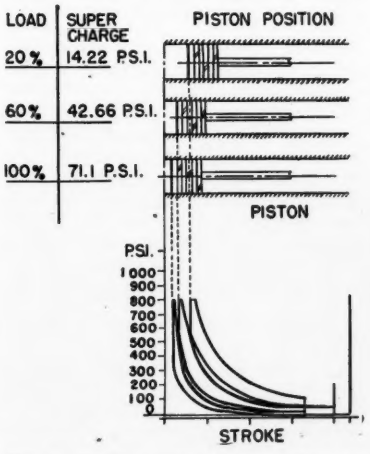

Fig. 5. Relative volumes and strokes for different loads on free-piston compressor. (J. G. Coutant)

[1] The Junkers design was described in detail in Mechanical Engineering, April, 1935.

[2] Combustion in Free-Piston Engines; *Southern Power and Industry*, November, 1944.

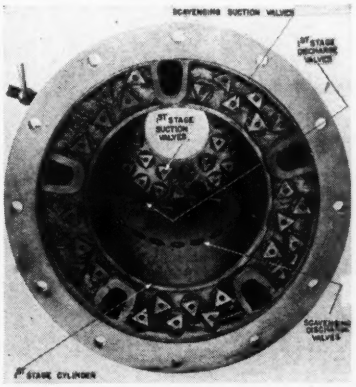

Fig. 6. Valves of the free-piston air compressor

Commercial Development

The free-piston compressor idea is not new. Two designs were patented in Europe, one in 1936 by R. P. Pescara in Paris and the other in 1934 by H. Janicke of Dessau, Germany. The latter was assigned to the Junkers[1] organization. Both operate on the 2-cycle Diesel principle. In this country, development work on the free-piston compressor is being carried on at present by at least one manufacturer of equipment.

All patents covering the equipment are now in the hands of the Office of the Alien Property Custodian. Copies of the patents may be had for 10 cents each and they can be manufactured on a non-exclusive basis on payment of a license fee of $15.

Variable Stroke of Free-Piston Engine

Aside from differences in the physical construction between the free-piston compressor and the internal combustion engine, one of the principal features of the free-piston compressor is that it has variable combustion chamber volume. In the conventional internal combustion engine, piston displacement is constant regardless of power output; the indicator card shows only pressure differences. In the free-piston engine, however, an indicator card would show both a change in pressure and

(Continued on page 112)

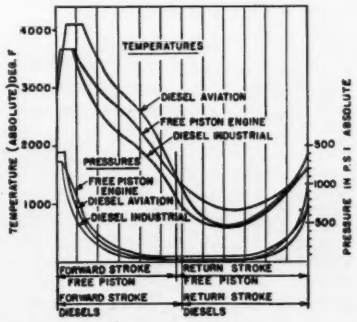

Fig. 7. Curves of pressure and temperature against time for free-piston engine, aircraft Diesel and industrial Diesel, all two cycle. (J. G. Coutant)

How to Prime Centrifugal Pumps*

By

Roy Carter

Application Engineer, Worthington Pump and Machinery Corp.

Part II . . . Central priming systems, in which one priming device serves more than one pump . . . Vacuum-controlled automatic priming system . . . Automatic priming system using ejectors . . . How and why two vacuum pumps are usually used on central priming systems . . . Consideration of stand-by units . . . Point of air removal . . . Automatic vent valves

WHEN THERE is more than one centrifugal pump to be primed in a station, duplication of a priming device for each pump can be avoided by having one priming device serve all the pumps. Such an arrangement is called a central priming system. If the priming device and the venting of the pumps is automatically controlled, the system is called a central automatic priming system. Figure 1 illustrates the method of piping up a central priming system.

Vacuum Controlled Automatic Priming System

A vacuum-controlled automatic priming system consists of a vacuum pump exhausting from a tank and controlled by a vacuum switch so that a range of vacuum, 2 in. to 6 in. Hg above that necessary to prime the pumps with the greatest suction lift, is maintained in the tank.

The priming connections on each pump served by the system are connected through automatic vent valves and piping to the vacuum tank. The vacuum tank is usually provided with a gage glass and a drain so that if any water accumulates in the tank because a vent valve leaks, it can be detected and the tank drained.

This type of system, illustrated diagrammatically in Fig. 2, is the most commonly used of the central automatic priming systems and has been made with both wet and dry motor driven vacuum pumps. A comparison of Figs. 1 and 2 shows that manually-controlled valves for priming have been replaced by automatic vent valves and operation of the vacuum pump is automatically controlled by the vacuum switch.

The vacuum tank, pump and controls of one well known make of such a priming system are shown in Fig. 3. The vacuum pump is a belt-driven dry type mounted with its motor on top of the vacuum tank. A vacuum switch on the side of the tank controls the operation of the vacuum pump. The contacts of this switch are closed if the vacuum falls below a certain value (16 in. Hg, for example) and are open if the vacuum reaches a certain higher value (20 in. Hg, for example).

In this switch there is an unloader, so the vacuum pump starts with atmospheric suction pressure and atmospheric exhaust pressure. As this unloader closes, the vacuum pump exhausts through a check valve (shown alongside the vacuum switch) from the vacuum tank and builds up

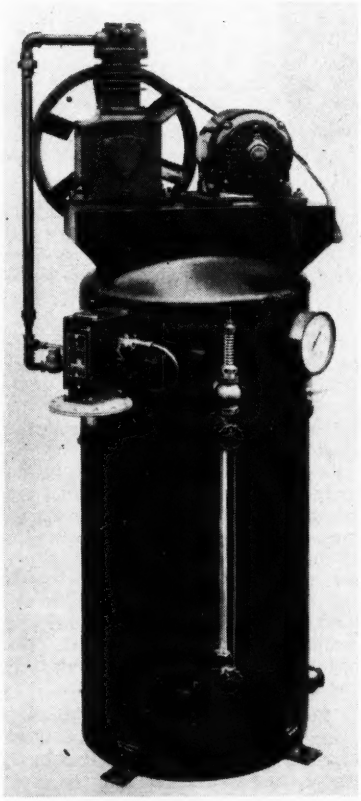

Fig. 3. Vacuum tank, vacuum pump and control for automatic priming system. (Valve and Primer Corp.)

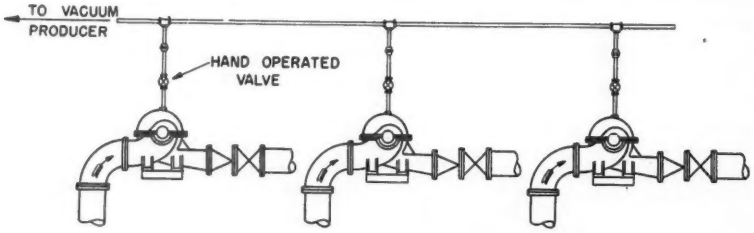

Fig. 1. Connections for central priming system

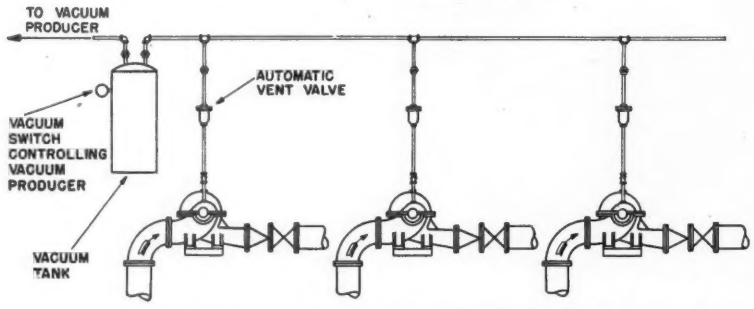

Fig. 2. Connections for central automatic priming system

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This is the second of a series of three articles by Mr. Carter. Part I, published in the March, 1946 issue, discussed manual priming, various vacuum-producing devices for priming, foot valves, priming chambers, ejectors, dry and wet-vacuum pumps for priming. Part III, to appear in a subsequent issue, will take up self-contained automatic priming units and systems for specific installations.

the vacuum until the contacts of the switch open, stopping the motor. The pipe connection for the vacuum line running to the various automatic vent valves is not shown in the illustration.

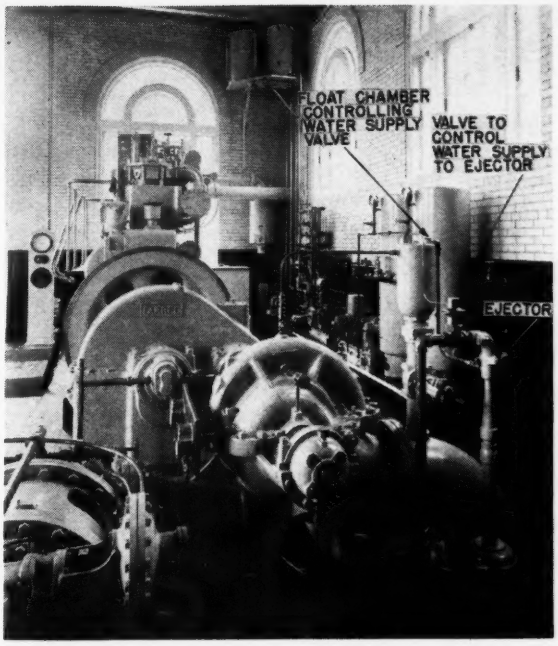
A gage glass on the tank is incorporated to show the presence of water in the tank if any of the vent valves should accidentally leak. Above the gage glass is a vacuum relief valve, set to admit air if the vacuum in the tank reaches a value above the upper limit of vacuum normally maintained. This will protect the vacuum pump against operation on a very high vacuum if the vacuum switch fails to open when the upper limit of vacuum is reached.

Automatic Priming Systems Using Ejectors

Automatic priming systems using ejectors are feasible and several systems utilizing water ejectors are on the market. Figure 4 shows an installation of one type using water from the discharge line of the pump. The flow of water to the ejector, Fig. 5, is controlled by its piston valve which is spring and water pressure actuated. This valve is governed by a float chamber, Fig. 6, mounted on the suction line.

Air is drawn from the top of the priming chamber until the water rises in it, lifting the float which, through mechanical linkages, closes the connection to the suction of the jet and also closes a second valve which, when open, relieves the pressure on the top of the piston of the water supply valve and allows it to open. The closing of the pressure relief valve in the priming or float chamber causes equal pressure to exist on both sides of the piston and the spring closes the valve, thus shutting off the water supply to the jet.

Fig. 4. Installation of centrifugal pump served by automatic water jet priming device



For use in installations where water under proper pressure is not always available, the same manufacturer has a unit, Fig. 7, consisting of a jet supplied with water under pressure by a small electric motor-driven pump mounted on a reservoir tank and arranged so the water is recirculated. With this unit the float chamber, Fig. 8, has a switch, actuated by the float, controlling the motor of the supply pump. The method of installation of the float chamber is illustrated in Fig. 9.

A third type, Figs. 10 and 11, made by another manufacturer, is similar in basic functioning to the first type but the water supply to the jet is controlled by a solenoid-operated valve. This is, in turn, controlled by electrodes in the priming chamber, so that the jet operates if the level of the water in the priming chamber falls so the longer electrode is uncovered and continues to operate until the water level rises and the shorter electrode is contacted by the water. As shown in Fig. 11, this design of priming system has the priming chamber mounted directly on the pump to be primed and the priming chamber is connected with a special venting arrangement to the top or tops of the suction waterways of the pump to be primed.

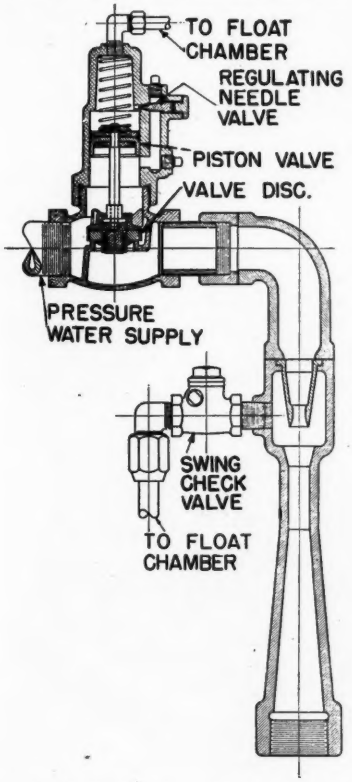


Fig. 5. Water jet primer with piston valve to control water supply. (Skidmore Corp.)

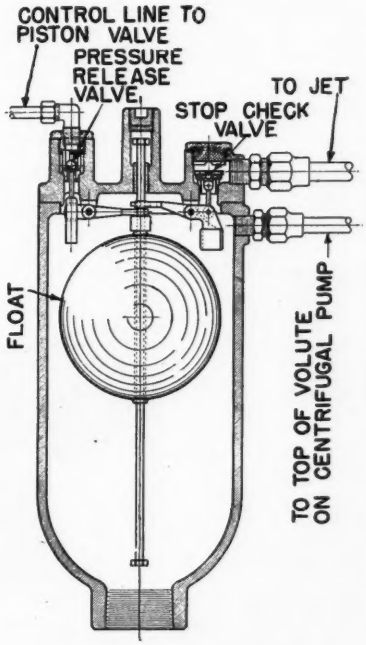


Fig. 6. Float chamber to control primer shown in Fig. 5. (Skidmore Corp.)

Two Vacuum Pumps Usually Used on Central Priming Systems

Most central priming systems are provided with two vacuum pumps, as illustrated in Fig. 12. This is desirable for two reasons. The first is that an outage of one does not put the system out of operation. The second reason is that the capacity of the vacuum pumps is selected for the normal leakage to be encountered after the pumps served by the system have been primed. When one of the units served has been out of service and it is desired to re-establish its prime, the amount of air to be removed is relatively large and the priming time would be quite long if a single vacuum pump is used. Fur-

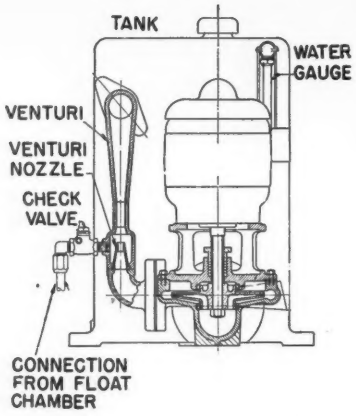


Fig. 7. Vacuum producer, using water jet, with motor-driven centrifugal pump to supply power water. (Skidmore Corp.)

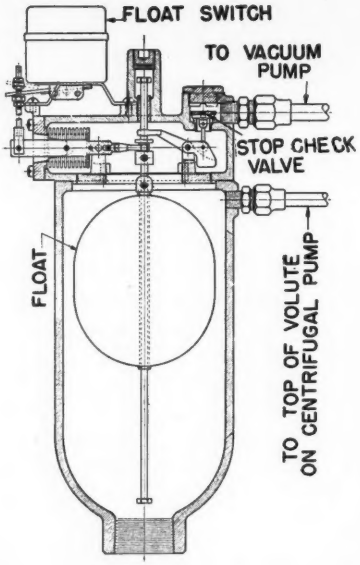


Fig. 8. Float chamber to control vacuum producer shown in Fig. 7. (Skidmore Corp.)

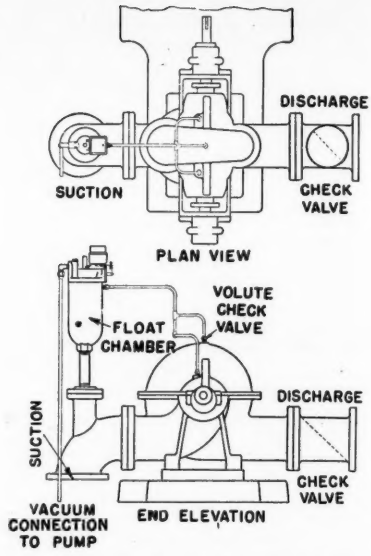


Fig. 9. Installation of float chamber shown in Fig. 8 on a double suction, single-stage pump. (Skidmore Corp.)

thermore, especially at the start of priming another pump, there would be a reduction in the vacuum in the priming system. This would be objectionable if any one of the units in service had accumulated air and the vent valve opened to vent this air.

It is usual practice with two vacuum pumps to have the control of one set cut in at some predetermined vacuum and the control of the second set to cut in at a slightly lower vacuum. Thus if the capacity of the one pump is sufficient to prevent the vacuum in the system from falling, the second pump does not start. Generally the controls are equipped with switches so that the sequence of starting can be changed and the use of the two pumps can be equalized.

Consideration of Standby Units

If a station having a central automatic priming system, using an electric motor-driven vacuum pump, also has standby units with auxiliary drive in case of electrical power failure, the standby units are usually kept fully primed by the central priming system. If these units are manually started and controlled, a standby, manually-controlled vacuum producer is generally installed. Thus with a vacuum tank type of priming system, with gasoline-engine driven standby pumps, a gasoline-engine-driven vacuum pump would also be installed and the operator would manually start and stop it as necessary to maintain the required range of vacuum in the vacuum tank.

Standby priming equipment that is automatically controlled presents a more complicated problem. One solution used for internal-combustion-engine-driven units is a direct-connected vacuum pump running continuously, either with a relief valve in its suction line or with an unloader

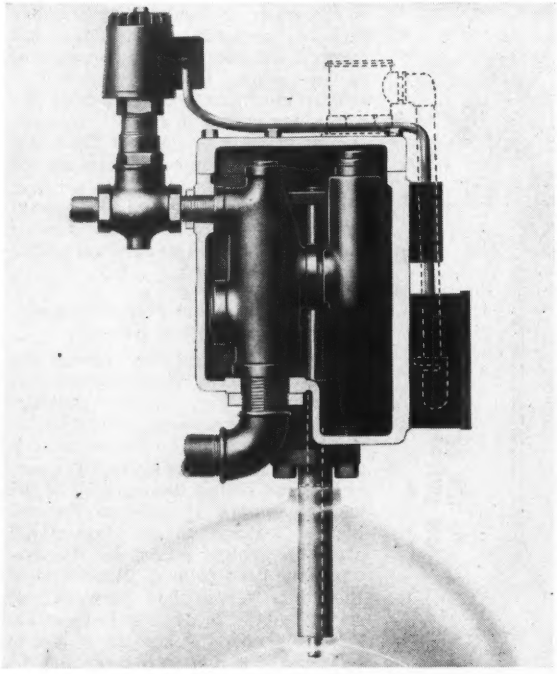


Fig. 10. Section of priming device using water jet with electrode and solenoid valve control. (DeLaval Steam Turbine Co.)

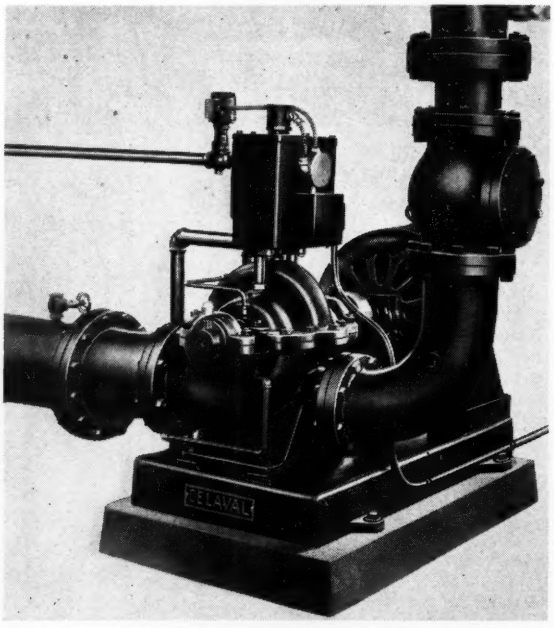


Fig. 11. Centrifugal pump equipped with priming device shown in Fig. 10. (DeLaval Steam Turbine Co.)

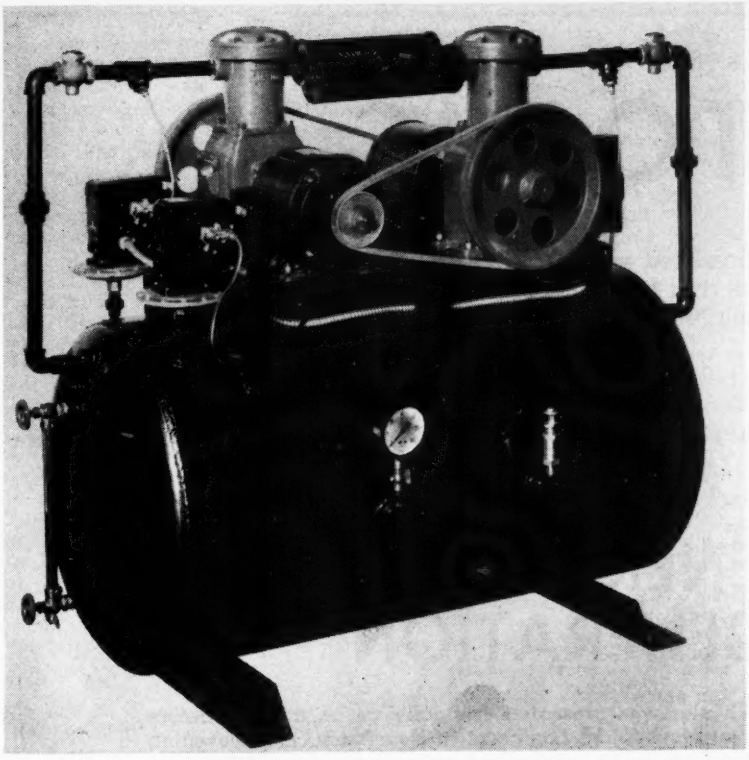


Fig. 12. Vacuum tank type of priming unit with two vacuum pumps. (Valve and Primer Corp.)

in the form of diaphragm valve controlled by the discharge pressure of the centrifugal pump. In either case, proper vent valves and check valves have to be incorporated in the priming piping. For steam-turbine-driven units, automatically controlled steam jet primers can be used.

Most systems of this nature are especially designed for the requirements of the installation.

Point of Air Removal

In most cases, air is exhausted from a centrifugal pump, when it is being primed, through the high point of the volute. Generally, it is possible to start a centrifugal pump if the liquid covers the eye of the impeller and wash out the remaining air entrapped in the casing by the flow of liquid through the pump. On some units, the priming is accomplished solely from the high point in the suction waterways, while on other units, notably large sizes, air is exhausted both from the high point of the volute and the high point or points of the suction waterways.

Automatic Vent Valves

Automatic vent valves consist of a body containing a float which actuates a valve located in the upper part. The bottom of the body is connected to the space to be vented. As air or gas is vented out of the valve, water rises in the body until the float is lifted and the valve is closed. A typical vent designed basically for vacuum priming systems is illustrated in Fig. 13. This shows a valve provided with auxiliary tapped openings on the lower part of the body for connection to the auxiliary vent points on the system. When one or more of these vent points are points of higher pressure, such as the top of the volute of the pump, an orifice is used to limit the flow of liquid. Such a constant flow of liquid from the discharge back to the suction means a constant loss and, where a unit is to be used more or less constantly, a separate valve is desirable.

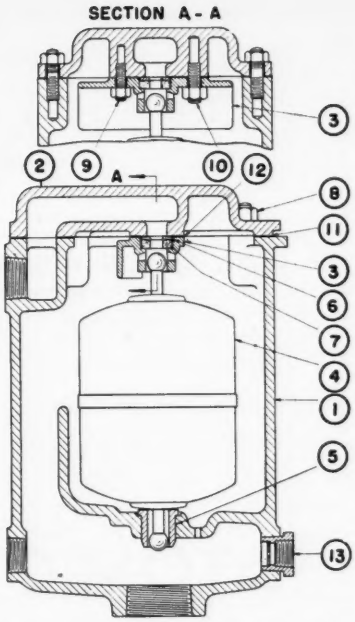


Fig. 13. Section of automatic vent valve. (Nash Engineering Co.)

In some systems it is necessary to prevent a reverse flow of air through the valve. This can be done by the addition of a check valve in the vent piping between the vent and the vacuum source. One make of automatic vent valve is designed so a ball can be inserted to act as a check valve.

In addition to their use with automatic priming systems, these automatic vent valves are employed alone without connection to a vacuum source to vent air from the passages of pumps and pipes that are under pressures greater than atmospheric. They are frequently used to vent air from pumps that have a positive suction head, thus insuring that the pump is always primed.

(To be continued)

High Temperature Liquid Energy Transfer

IN A FEW YEARS it may be entirely practicable for an owner to have in his home one fuel burning device which will furnish the energy for house heating, hot water, refrigeration, cooking, baking, ironing, and generating electricity for lighting and other purposes. To the engineer, the use of separate forms of energy for several of these functions seems somewhat inconsistent. Consideration has been given to the use of one energy source. A method of accomplishing this by employing one fuel-using device, which can burn coal, gas or oil, and from which a hot liquid is circulated to various other apparatus to provide energy for the various functions was described recently before the ASH & VE annual meeting by Orion G. Oaks, chief engineer, John Pierce Foundation, Raritan, N. J.

The liquid used is described as tetracresylicate, with a boiling point of over 800 F and a solidifying point at 65 F below zero. The experimental installation developed by Mr. Oaks includes a boiler, a unit heater, hot water heater, steam generator, refrigerator, and cooking unit.

When required, electric energy is produced by means of a heat exchanger or boiler producing superheated steam at pressures up to 750 psi. This steam is utilized in driving a steam turbine connected to a generator.

The apparatus is not yet ready for the market, the purpose of the investigation reported being to demonstrate practicability.

ATOMIC

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

ATOMIC ENERGY FOR POWER GENERATION

This article by Dr. Wheeler was presented originally as an address before the American Society of Mechanical Engineers in New York on the evening of January 30. His comments on the possibilities of an atomic power plant are particularly significant in view of the fact that he was associated with the design and operation of the plutonium production plants at Hanford, Washington

By John Archibald Wheeler **Associate Professor of Physics, Princeton University**

I HAVE just returned from the atomic energy plants of the Hanford Engineer Works, located near what was once the little agricultural town of Hanford, Washington. The plants lie in a country of sagebrush and sand on the bank of the beautiful blue Columbia River, about halfway between the Grand Coulee and the Bonneville Dam. I can testify that one could not ask for a plant which is quieter, smoother running, or more reliable. I have followed this plant from its start-up on September 26, 1944, over the period of the past 16 months and can say that the possibility of the controlled release of atomic energy does not have to be proven—*it is an accomplished fact.*

The Hanford plant was not built to generate nuclear energy, however; its purpose was to synthesize a new chemical substance, plutonium, element 94, to make atomic bombs. The production of heat in this reaction was not merely incidental; it was a positive drawback in the program to make as much plutonium as possible. For example, the production of as much as one kilogram of plutonium per day requires the release of an amount of heat between one half million kilowatts and one and a half million kilowatts. From this figure it will be evident that problems of heat transfer and heat dissipation controlled the capacity of the Hanford plants to synthesize plutonium. These problems are engineering problems.

In the nuclear energy plant of the future the liberation of energy in the form of heat or otherwise will be the primary objective and the production of plutonium or other substances subject to nuclear fission will be secondary. But the most difficult problems will still be engineering problems: first, to transfer heat from the chain reacting structure, the so-called pile, to a cooling fluid, and second, to convert this heat into useable energy. The problems of nuclear physics which enter into the design of the power producing pile of the future have in principle been solved. Let me report the concensus of opinion of the industrial men and the scientists who have been connected with the uranium project. Assuming freedom to develop, they agree that it is only a question of time before we shall have an industrial technology of nuclear energy which can pay its own way. And that time interval will depend most of all upon the engineering talent which is applied to the solution of the engineering problems of the pile.

As engineers you are thorough in analyzing engineering problems, and you will not be content to have me speak of the problems of pile design only in general terms. You will want to know for yourself something of the nature and principles of nuclear reactions. You will want to see how this knowledge allows us to predict what types of nuclear power plants are possible. Accordingly, I shall begin by outlining the nature and action of what might be called the nuclear power plant of the future. Then I shall survey in a little more detail the principles of nuclear physics which enter into the design of that plant as well as of the already existing Hanford piles. After that I shall discuss some of the engineering problems of these piles. Finally, I shall try to assess our present rate of progress towards the industrial pile of the future, indicating the importance of this development to our future national defense and what we can do to speed it up.

The Pile of the Future

As for the first of these topics, the pile of the future, nuclear physics tells us that this power plant will be in six important ways quite similar to the present Hanford piles. First of all, the heat-releasing reaction will be fission, the division of a heavy atomic nucleus into two parts of approximately equal mass. We can exclude from consideration other transformations such as the reactions of lighter atomic nuclei which provide the heat of stars. These reactions occur at a significant rate only at temperatures between one million and fifty million degrees. That it will not be feasible to make industrial plants operating at such enormous temperatures is clear enough when one observes the destructive power of a body as hot as an atomic bomb. Nuclear fission, on the other hand, requires for its production, not high temperatures, but only bombardment of the nucleus in question by the elementary particle known under the name of neutron. Without inquiring more about the nature of this particle just now, we can note that not only is one neutron sufficient to produce fission, but also that the act of fission produces in turn several new neutrons. The release of these particles at the time of splitting will not come as a surprise to anyone who has observed carefully the mouth of a slowly dripping water faucet. As each big drop breaks away, several tiny droplets are formed and thrown out from the point of division. This rather minor side reaction in the process of breaking off a water droplet is all-important in the act of fission, for it provides several neutrons, each of which can produce a further fission process, provided that more nuclei are available which are susceptible to nuclear fission.

Principles of Nuclear Physics

This requirement brings us to the second feature of the present chain-reacting units which will be preserved in the piles of the future: we require as source of energy a substance which undergoes fission with high probability when struck by a neutron. There are only a few nuclear species which satisfy this condition. They are all comparable in atomic weight to uranium, or heavier than it. The two most prominent examples of such fissionable materials are plutonium-239, the most important variety of the new and 94th chemical element; and uranium-235, the variety of nucleus which is present to one part in 140 in ordinary uranium. Both nuclear species play an important part in the Hanford piles. The U-235 undergoes fission and thus maintains the nuclear chain reaction. Most of the extra neutrons not needed for continuance of the chain reaction are used in synthesizing the new fissionable element, plutonium. The pile of the future must

Editor's Comment

AS HAS BEEN pointed out in the preceding articles presented in this section, the atomic bomb was not a step on the road to the production of controlled atomic energy. The control of atomic energy had been established at the University of Chicago when the first self-sustaining nuclear chain reacting pile went into operation in December, 1942. The quiet operation of that pile with the steady evolution of heat, showed conclusively that heat energy could be derived from nuclear reactions on a perfectly controllable basis. Later, in the operation of the great plutonium plant, the Hanford Engineer Works near Pasco, Washington, the production of heat was the only limiting factor. The production of heat in the plutonium reaction was not merely incidental, it was a positive drawback in the program to make as much plutonium as possible. Only the fact that enormous quantities of clear cold water from the Columbia River were available made the plant possible.

This large-scale production of heat from the plutonium pile immediately suggests its use for heating and power purposes. Obviously, if the pile heats water, why not heat it until it turns into steam and thus provide a nuclear-steam power plant. Or instead of using water for cooling in such a pile, air or other gas could be used, and the heated gas made to drive a gas turbine.

In conception, all of these schemes are simple. All you need is a sheet of blank paper and a pencil, and almost anyone can sit down and draw diagrams of a number of different kinds of nuclear power plants.

Theoretically, such plants are quite possible, but practically a great deal of engineering work has to be done before such plants can be built. The problems to be solved, however, are only engineering problems which can, and will be solved, if we really want to build such plants.

At the present time, despite the great interest in the matter by scientists and engineers, little can be done until the control of atomic energy is taken away from the military and placed in charge of civilians. At the present time the Army demands continued control, with Major-General Groves flatly declaring that the scientists who discovered and developed atomic energy should be barred from any commission controlling it. Scientists on the other hand accuse the military of "preparing for the last war," of seeking to devise counterstrategy against planes carrying Nagasaki-type atomic bombs instead of grasping the true realization of what a future atomic war might mean. As was indicated in the article in the March issue, if such a war materializes, no one could win it. The destruction would be so vast that civilization itself would receive a stupifying if not a mortal blow.

Until this question of who is to control atomic energy is settled, there can be little active development of nuclear energy power plants. Several groups of scientists, however, working with engineers are ready to go ahead with the design of actual power plants just as soon as they obtain the necessary permission from the government authorities.

What the general pattern of the first nuclear energy power plant will be, no one can predict with any degree of exactness at this time but it will undoubtedly utilize the heat released in the production of plutonium from U-238. Whether water will be used, depend upon what temperature and pressure relations can be worked out. It is quite possible that a fluid, other than water, capable of going to much higher temperatures than water without requiring very high pressures will be used. As pointed out in the accompanying article by Dr. George A. Wheeler, high pressures would require heavy piping but such heavy piping would absorb many neutrons and this would make it difficult to run the unit efficiently. As far as temperature is concerned, that is a factor of relatively little importance so far as the effectiveness of the nuclear chain reaction is concerned. It matters little to the fission fragments whether the temperature of the uranium is a few hundred degrees or over a thousand degrees for their own instantaneous energy at the instant of fusion is equivalent to more than a billion degrees.

While the state of development of nuclear physics at the present time does not permit us to devise a nuclear power plant on principles other than those involving the release and absorption of heat, it is impossible to predict what future discoveries may bring. As Dr. Joseph Slepian of Westinghouse pointed out at the AIEE winter convention in New York recently, the state of development of nuclear fusion, now, can be compared to that of the X-ray fifty years ago. At that time, though we had the X-ray tube and knew something of the possibilities of X-rays, no one could have foreseen that this tube would even-

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(Continued from preceding page)

tually bring about the vast radio industry, that it would make world-wide telephony possible, or that it would lead to such things as radar and the proximity fuse. Yet all of these developments are based on the electron tube and the X-ray tube was our first practical electron tube.

It is not beyond the bounds of possibility that some day, some method will be developed whereby nuclear energy is converted directly into electrical energy. In one of the early articles of the series published in this section, it was stated that if it were possible to isolate two kilograms of electrons and that if these electrons were divided into two equal parts and placed at a distance of 8000 miles from each other, the two masses would repel each other with a force of 195 million, million tons. Suppose then, that by means of some super powerful neutron ray, we could strip all the electrons from a fraction of a milligram of matter and deposit them on a suitable collector, connected to a large power system; such an arrangement would, once and for all time solve all our power problems and completely upset the present economic order.

Until even the germ of the ideas underlying such techniques are born, however, we must content ourselves with the means at hand, which, at the present time involves the use of heat. The first nuclear energy power plants will probably be something like our present day steam plants except that the boilers will be self-sustaining nuclear reaction piles.

Since there is a prospect of such plants being developed in the near future, we believe that the readers of Power Plant Engineering will be interested in knowing the thoughts and ideas about such plants and the general state of development, of a man who has been intimately associated with the design and operation of the Hanford Engineer Works in Washington. This man is Dr. John A. Wheeler, Associate Professor of Physics, Princeton University. His article, presented here, is the substance of a paper he presented recently before the ASME in New York, upon his return from the atomic energy plants in Washington. He has been closely associated with the operation of these plants and, therefore, speaks with authority. Only 34 yrs old, Dr. Wheeler has won world recognition for his part in the development of atomic energy. In 1939 he was successful in solving the mechanics of nuclear fission, working in the laboratories at Princeton. He assisted in design and construction of the plutonium plant in Hanford and in 1944 went to Hanford as advisor to the operators of the project.—A. W. Kramer

operate by fission of one or other of these two substances or of some nuclear species very near to these two in the periodic system of the elements.

Unfortunately none of the desired fissionable species of nuclei exists in nature in anything but insignificant traces, except for U-235. Furthermore, the task of separating U-235 from ordinary uranium is difficult and expensive. Consequently it is reasonable to ask of the pile of the future a third feature, that it should synthesize by a suitable side reaction as much as possible of the fissionable material which is burned up during operation. Here again the Hanford piles point the way. At the same time that their operation burns up the one fissionable material, U-235, it creates the new and equally desirable fissionable species, Pu-239. In partial explanation let me say that the process of synthesis starts with the very abundant but otherwise useless nuclear species, U-238. This species, by capture of a neutron, and a resultant sequence of changes, is transformed into the wanted Pu-239. One may ask, if the heat given off in this reaction was such a source of engineering difficulty in the war program, why bother to go to all the trouble to destroy one perfectly good bomb-making material in the course of making another one? The answer is simple. It was much easier to separate out from the original element, uranium, the new and chemically distinct element, plutonium, than it was to separate two forms of uranium from each other. The whole point of the Hanford program was to avoid the problem of separation of two different species of the same chemical element and to replace it by the problem of chemical separation of two distinct elements. It paid to do this in spite of the heat transfer difficulties which were encountered and in spite of the fact that all the heat was thrown away. However, in the pile of the future, where the heat energy will be the primary point of interest, considerations of economy will give us the same incentive we had to produce fissionable material from an otherwise relatively useless raw material such as the abundant U-238.

ATOMICS

Consumption of Raw Material

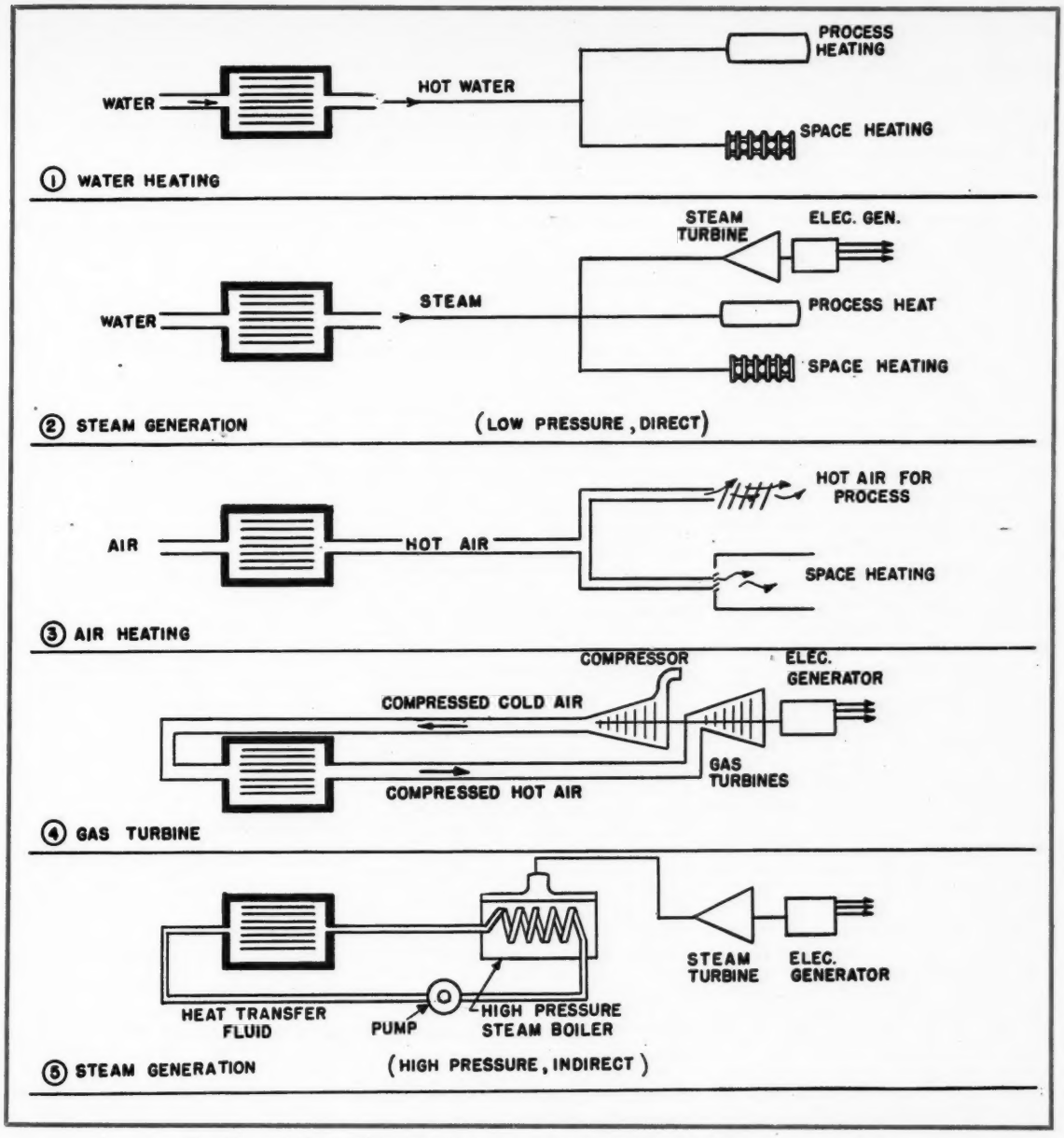
In future attempts to accomplish this regeneration process, there will be one or other of two possible outcomes. It may be that each day of operation of the pile of the future will burn up, let us say, one kilogram of the original fissionable material and regenerate out of U-238 or similar inert material possibly only 0.9 kilograms of new fissionable material such as plutonium. In this case the plant can continue operation only if we supply from outside each day 0.1 kilogram of new fissionable material. This requirement will prevent atomic energy from becoming quite as cheap as we should like to have it.

The other possible outcome is more favorable to economy of raw materials. In every day of operation in which we destroy one kilogram of fissionable material, we synthesize from an inert substance more than one kilogram of new fissionable material, say for example 1.1 kilograms. In this case we leave 1 kilogram of the new product in the plant to make up for the losses of the day and remove the other 0.1 kilogram to help start up a new pile; or, if necessary, to help make atomic bombs. In case we can achieve this outcome, there is no need for us to supply new fissionable material to our plant from the outside, except to get it started. After it is in operation we could even feed it as raw material uranium from which all of the active constituent, U-235, has been extracted, although it would be cheaper to use natural uranium. The plant itself will convert the inactive uranium to fissionable material for use in the chain-reaction. Evidently we have only to design a plant with sufficiently good regeneration characteristics in order to use for power purposes all of the uranium, not merely the rare constituent U-235.

However good the regeneration characteristics of our future power plant, or in other words, however efficiently we use the raw material, we must obviously still have a continuous supply of raw material. This requirement brings us to the fourth point of similarity with the Hanford chain-reacting units. It will be necessary in the future as in the past to use for raw material either uranium itself or possibly, we may hope, some other element of comparable abundance on the earth, but with a neighboring or higher position in the periodic table of the elements. The only such substance which exists in nature is *thorium*, an element apparently somewhat more abundant than uranium. Consequently the pile of the future will be expected to use as source of energy either uranium or possibly thorium.

Chemical Plant

There is a fifth requirement on the nuclear power plant of the future which is not so obvious as those which have gone before. Associated with the power unit there should be a chemical plant for the treatment both of the raw material and of the



Possible methods of utilizing the heat energy resulting from controlled nuclear reactions

fissionable material after they have been exposed in the pile. We will expect different locations to be chosen for these two materials to get the best results. But as time goes on fissionable material will be synthesized within the relatively inert raw material. If this fissionable substance is allowed to stay where it is, it will eventually be struck by a neutron and be caused to split, but to split at a point in the pile where the neutrons which it gives off will not be used with full effectiveness. To avoid this loss of efficiency, which might be serious, we must expect to have to withdraw the raw material periodically from the unit and extract from it the newly synthesized element. The two components that result from this chemical separation process will then be sent back to their proper places in the pile, the raw material to one location, the fissionable material to another.

This is not the only task which the chemical plant will have to perform. The fissionable material will also experience changes which will call for its reprocessing. The products of nuclear fission, elements of medium atomic weight like barium, lanthanum, xenon, rubidium, selenium, tellurium, silver, ruthenium, will accumulate and poison the chain-reaction by absorbing the neutrons which we want for more productive purposes. Consequently we will expect to have to remove these by-products of the recaction from time to time from the fissionable material, whether this material is U-235, Pu-239, or something else.

Of course the separation plant of the Hanford pile does only a part of what we demand of the separation plant of the future. It only withdraws from the working material the plutonium which was required for atomic bombs. It is designed to produce plutonium by the most straightforward possible means, with no at-

tempt to serve as a power plant. Consequently it does not need to prepare the working material, uranium, for reintroduction into the unit.

Protection against Radiation

Sixth and last major point of resemblance between the future plant and the Hanford pile is the requirement of protection of human beings from radioactive radiations. Not only does the act of fission liberate fast and penetrating neutrons, but it also releases electromagnetic radiations which have the same character as X-rays and even greater piercing power. The so-called gamma rays, together with the neutrons coming from a pile in full production, have near such a reactor an intensity more than a million times as great as can be tolerated biologically by the human organism. It is necessary to surround the pile with a shield which will cut down the intensity of these radiations to a negligible level. You can imagine the difficulties which arise in obtaining complete protection when you consider that there must be openings in the shield for the entrance and discharge of the cooling fluid and for the insertion and the removal of uranium or other working material before and after irradiation. I am glad to say that these structural problems not only can be solved, but that they have been solved at the Columbia River plants, and solved in a very satisfactory way.

However, I am sorry to have to report also that the required shielding weighs a great deal. Even for a unit generating as little as a 100 kilowatts the shielding has a thickness of a number of feet and weighs of the order of magnitude of 50 tons. Unfortunately there is no trick at our disposal to overcome this difficulty. The principles of shielding are very simple and straightforward. What counts is essentially the product of the thickness and the density of the protective material. This circumstance means that even with the densest practical materials there is a minimum required thickness for the shield. It might just be possible to carry such a shield through existing railway tunnels on a locomotive driven by nuclear power, but the prospects for train propulsion are not bright. Atomic power appears to be quite out of the picture for automobiles. The same conclusion applies also to airplanes, at least until their weight-carrying capacity reaches ten to a hundred times its present figure. On the other hand, it is quite in order to count on nuclear energy for driving ships, or for running a stationary electric power plant. In neither application does a heavy shield cause too much difficulty. And fortunately, the required weight of the protective material does not increase greatly with power level. Consider a shield thick enough to reduce to a biologically acceptable intensity radiations from a pile which in the absence of shielding would be a million (10^6) times too intense. Increase the power output of this pile tenfold, so that the radiation is ten million (10^7) times the acceptable level. Then it is only necessary to increase the thickness of the shield in the ratio of seven to six or 17 per cent to shield the ten times more active pile.

Some emission of radiations continues even after the chain reaction is brought to a halt. Some of the products of nuclear fission, elements of medium atomic weight, are radioactive when formed. These active materials are present in the irradiated uranium which is discharged from the Columbia River piles, and therefore in the uranium which is received by the chemical separation plant at Hanford. What is true of this separation plant will be true of the chemical plant associated with all future piles: shielding is indispensible. To give an impression of the magnitude of the shielding problem, I may mention that there were poured at Hanford 780,000 cubic yards of concrete. Of course this amount of material was distributed over several plants, and only a part of it went for shielding purposes. Still it recalls to me the nurse who like so many others at the plant before Hiroshima was speculating about what the purpose of the huge development. "Why do you suppose they want all those tremendous concrete walls?" she asked aloud. One bystander piped up, said his private guess was that the plant had something to do with atomic energy. "Atomic energy," she snorted, "why don't you know that an atom is no bigger than a marble?"

The moral to be drawn from this discussion is that an atomic power unit is not a little gadget that you screw to the handlebar of a bicycle, but that it really involves a sizeable industrial development. The magnitude of even a single plant is necessarily so great, that it may possibly not be economically feasible unless it is designed to produce at least as much as perhaps 100,000 kilowatts of power.

We have reviewed briefly the six features common to present and future plants: the reaction is fission; there must be present a basic material to undergo fission; the pile, however, must produce new fissionable material; for this purpose the raw material will be uranium or possibly thorium; along with this we require a chemical separation plant; finally, heavy shielding is necessary. With these broad features sketched in, it is easy to complete the picture of the pile of the future. We have said not a thing about cooling fluid, assuming its existence implied by the term "power plant." In the Hanford piles the cooling fluid is water; in the future power plant this fluid will be some substance capable of going to much higher temperatures than water without requiring very high pressures. High pressures would require heavy piping; but every foreign material introduced into the pile absorbs neutrons and makes it that much more difficult to run the unit efficiently. In contrast to the pressure, the temperature of the pile is a matter of relative indifference from the point of view of the nuclear chain reaction. It matters little to the fission fragments whether the temperature of the uranium is a few hundreds of degrees or more than a thousand degrees, for their own instantaneous energy at the moment of production is equivalent to more than a billion degrees. It will therefore be reasonable to operate at as high a temperature as our materials of construction will stand, and gain all the thermodynamical efficiency that we can in our power plant. The cooling fluid, whatever it is, will then be led out to a heat exchanger. There its energy will be turned over to water or mercury or some other substance capable of driving a turbine or other prime mover. That is the power plant of the future.

Brighter, More Efficient Mercury Lamp

USE OF MERCURY-VAPOR lighting should receive a tremendous impetus from a new 60,000 lumen lamp developed at the Westinghouse Lamp Division, Bloomfield, N. J. The 1000-watt unit has a lumen-per-watt efficiency half again as good (60 as against 40) as the three sizes of the mercury-vapor lamps available for use without special cooling systems (100, 400, and 3000-watts). The greater efficiency results from an increase of about four times in pressure of the mercury vapor. Lamps of this rating have previously had to be water-cooled. Furthermore this new lamp has a mogul-screw base instead of a connection at each end of the tube. The lamp is not restricted in burning position.

The light is created in an arc stream about the shape and diameter of a cigarette and twice as long. It is enclosed in a quartz housing, in turn surrounded by a hard-glass exterior. Overall the lamp is only 14 in. long and less than four in. in diameter.

Because of its high efficiency, large light output, and small size (which means a small fixture) this lamp will have many general industrial lighting uses. Especially will it be of advantage where fixtures are mounted in high bays.

Short-Circuit Contributions of the Induction Motor

By L. G. LEVOY, JR.

Schenectady, N. Y.

Industrial Engineering Division General Electric Company

INDUCTION MOTORS contribute short-circuit current to electric system faults, and this influences the selection of circuit breakers. The correct application of circuit breakers generally requires a knowledge of fault current magnitude, both momentary and sustained, as well as normal load current.

However, modern low-voltage a-c circuit breakers (600-volt and below) operate so rapidly that their interrupting ratings are based entirely on momentary values of fault current.

It frequently occurs in industrial applications that the load consists largely of motors, either synchronous or induction, or both. Now it is readily accepted that synchronous motors contribute to the fault current magnitude in the same way that conventional alternators do. However, the manner in which induction motors contribute to fault current is less appreciated, even though their contribution may also influence the size of the circuit breakers selected.

The fact that induction motors contribute to system fault currents has been known for a long time. The effect was studied by Messrs. R. E. Doherty and E. T. Williamson in 1919 and a summary of their findings, including methods of calculating this current, was published in the 1921 AIEE Transactions.

The oscillograms illustrating this article show this effect in a practical case. These oscillograms were taken on wound-rotor induction motor rated 150 hp, 440 v, 60 cycles, 3 phase, 10 pole, 720 rpm. The external rotor resistance was short-circuited in each case shown, so that the effect is similar to that which would be obtained with a low resistance, squirrel-cage induction motor.

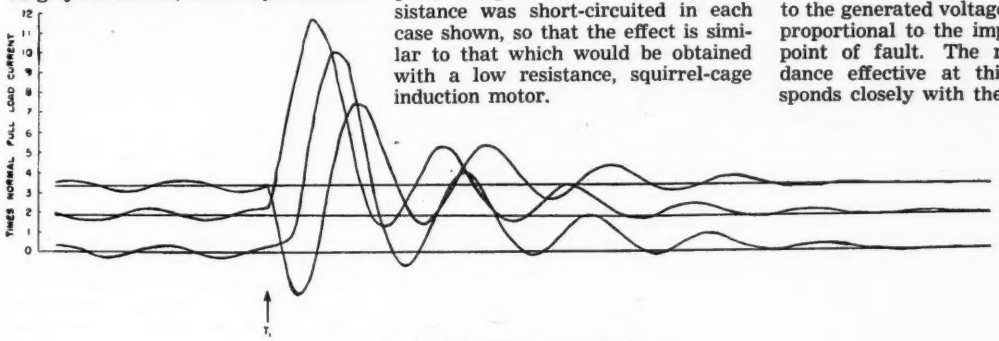


Fig. 1. Motor initially running light

Shown in Fig. 1 is the primary current when the machine is initially running light, and a solid three-phase fault is applied at a point in the circuit close to its input (stator) terminals at time T_1. The current shown is measured on the motor side of the fault so that the fault current contribution from the source of power does not appear, but only that contributed by the motor. (See Fig. 3 for test connections.)

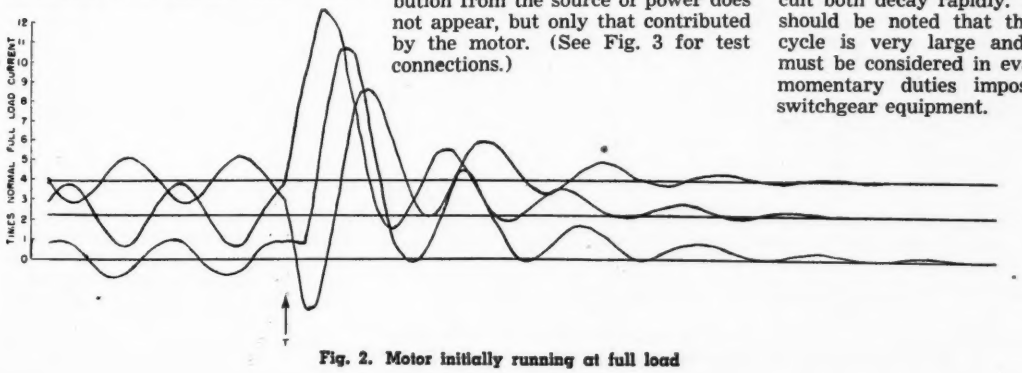


Fig. 2. Motor initially running at full load

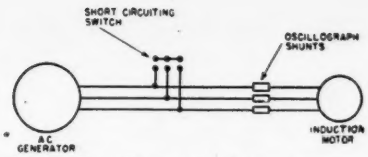


Fig. 3. Test Connection. Set-up for measuring fault current contribution of an induction motor

Fig. 2 shows the primary current in the same motor initially running under full load and a solid three-phase fault is applied at time T_1. Note that the maximum current occurs in the lowest trace on the oscillogram and is about ten times rated full load current. This includes the d-c offset component which is present in this current. The decrement is high and the current vanishes almost completely in four cycles, since there is no sustained field current in the rotor to provide excitation as in the case of a synchronous machine.

At the instant of short-circuit, the magnetic flux in the rotor and stator is normal. This rotor flux acts the same way as in the case of a synchronous machine, generating voltage in the stator, and causing a current to flow in the circuits consisting of the stator windings and connections to the fault. This current is proportional to the generated voltage and inversely proportional to the impedance to the point of fault. The machine impedance effective at this time corresponds closely with the impedance at standstill, and, consequently, the initial symmetric value of short-circuit current is approximately equal to the full voltage starting current of the motor.

The d-c offset component and the a-c symmetric component of current in the primary following short-circuit both decay rapidly. However, it should be noted that the first half cycle is very large and, therefore, must be considered in evaluating the momentary duties imposed on the switchgear equipment.

What the Power Engineer Needs to Know About

THE SCREW CONVEYOR

Advantages of the screw conveyor . . . Capacities . . . Application as distributing screw above storage bunker . . . Layout for a small plant . . . Coal weighing layout . . . Handling ashes . . Estimating power requirements . . . Author's comments

By Wilbur G. Hudson

Consulting Engineer

FROM THE VIEWPOINT of the power plant engineer, the screw conveyor for handling coal has the advantage of simplicity, low investment, dustless operation and low cost of replacements. For handling ashes, if properly constructed, it has similar good points.

Primarily it is a conveyor for small or moderate capacities, and although the largest listed standard size (24 in.) has a capacity of 250 tph at 70 rpm, where such a capacity is involved some other type of conveyor usually is specified. For one thing the power requirement is high, about double that required for a roller chain conveyor.

If the path is inclined upward the screw conveyor may be handicapped because its capacity decreases rapidly with increase in slope (Fig. 1). It will be noted that with a standard pitch helix and U trough, the capacity when inclined at 20° is about 55 per cent of the horizontal capacity. At 30° this is reduced to 30 per cent. If the screw is inclined at 45° the coal still will push along the floor of the trough, but at a very small rate.

Distributing Screw Above Storage Bunker

One frequent application is a distributing screw above a storage bunker. It then may have an open-bottom trough so the coal will feed out over the advancing crest of the pile. However if the bunker conveyor is fed from a preceding conveyor of the same capacity it will overload, because the coal drags across that in the bunker, substantially retarding forward movement as compared with that when moving on a polished steel trough. The bunker conveyor should have at least 20 per cent greater rpm to compensate for this retardation.

If coal is lumpy it is advisable to have ample clearance between helix and trough to minimize cracking of lumps and jamming. A 12 in. conveyor will handle slack coal with lumps up to 2 in. if there are not too many (not over 25 per cent). With sized coal this is reduced to 1 in.

If the screw conveyor is of unusual strength, we must be careful that the torque capacity of the standard spindle (pipe shaft, couplings and coupling bolts) is not exceeded. However the manufacturers will provide special sizes of pipe and coupling when necessary.

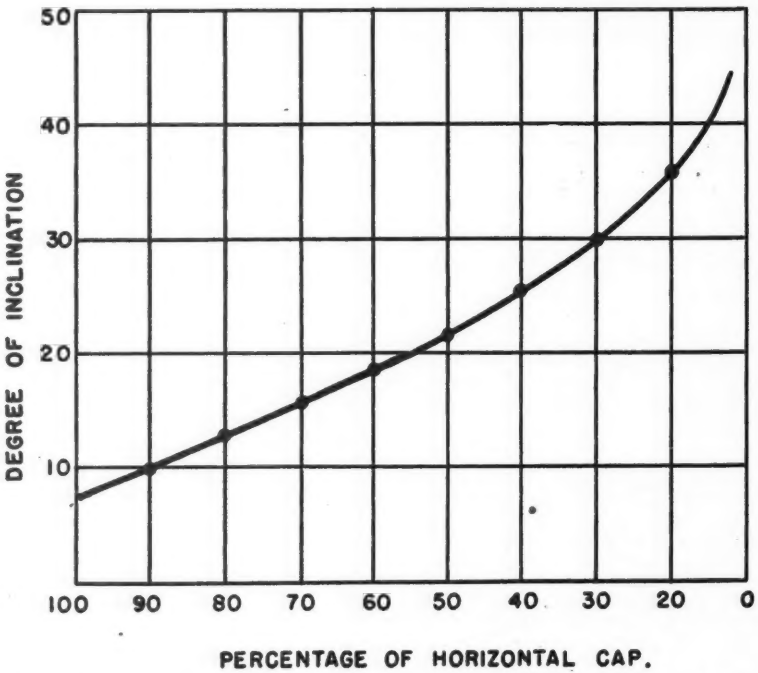


Fig. 1. Curve showing reduction in conveying capacity of standard pitch U-trough screw conveyor at various inclinations (with slack coal)

Layout for Small Plant

Fig. 2 illustrates the simplicity of a screw conveyor layout for a small plant. At the rear above, is a storage bin with two gates. The cross conveyor is half right-hand and half left-hand, to deliver at mid-length to the stoker screw, equipped with automatic stop located just above the stoker hopper. Both units are driven by a single motorized reducer. It would be quite easy here to have an automatic starting switch near the bottom of the stoker hopper to re-start the conveyors when the hopper needs coal, thus making the operation completely automatic except when coal hangs up in the bin.

Coal Weighing Layout

When coal is to be weighed, and a larry is proposed, the layout may be as indicated in Fig. 3. A self-feeding screw extends from an outside bin to within the boiler room with discharge opening above the larry hopper when in loading position. Two contactors

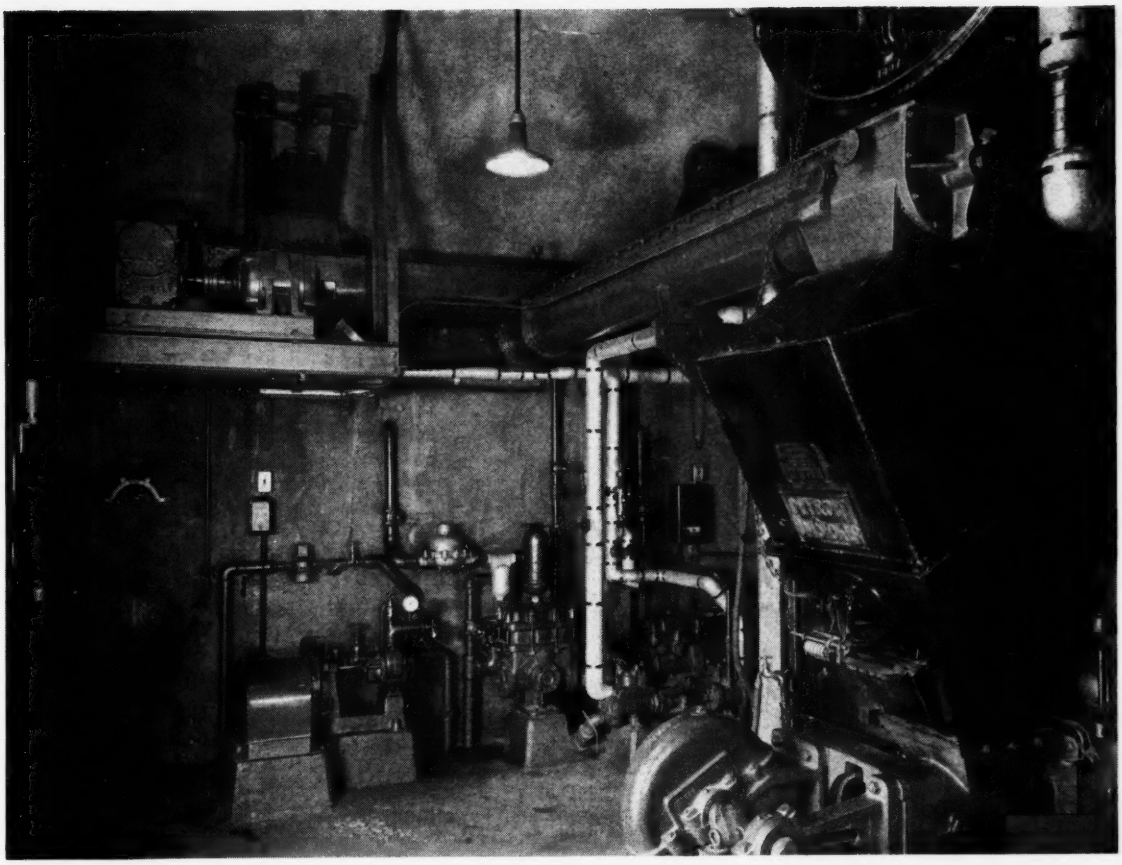


Fig. 2. Coal handling installation for a single stoker plant. Cross conveyor at rear is R. H. and L. H. to bring the coal from either end to the discharge above the stoker conveyor. Both units are driven by a single motorized reducer, which is stopped automatically when the stoker hopper is filled to capacity

are connected in the motor circuit: one is actuated when the larry is pushed to the end of its runway, and starts the conveyor, the other breaks the circuit when the hopper goes downward a fraction of an inch under its load. As an alternative to the larry there might be an automatic scale (Richardson or similar) between the coal bin outlet and a distributing screw. This reduces the dust nuisance somewhat, but is inconvenient when a record of coal to each boiler is desired.

Not Well Adapted to Automatic Distribution

For automatic, or continuous distribution from bin to stokers the screw conveyor is not well adapted. Assume there are ten stokers in line, averaging one ton per hour consumption each. Usually one or two boilers may be off the line as spare or for repairs. A capacity of ten tons per hour will leave a surplus of one or two tons per hour which will pile up on the floor beyond the last stoker. This occurs whenever the steam load is reduced, which happens at intervals in most industrial plants. The difficulty can be corrected to some extent by a variable speed drive, but the fireman must pay attention to what happens at the far end. If he is the one who does the shoveling of surplus, he usually will.

Of course the distributing screw may be paralleled by a return screw so that the surplus is re-circulated, but this introduces a difficulty back at the loading point. A horizontal runaround continuous flow conveyor is better here. It will cost more than two screw conveyors, but can be made almost completely automatic, within limits. It will be discussed in a later article.

Considerations for Periodic Stoker Service

Even for periodic stoker service there are some angles to consider. If all ten boilers above are on the line, and the conveyor has a capacity of 20 tons per hour, it may be started every half hour, will run for about fifteen minutes and then be stopped by a mercoid switch, or similar device, in #10 stoker hopper. But if, say, #8 and #9 go off the line, the conveyor when re-started will pour too much coal into #10 hopper, and the mercoid will stop the conveyor before some of the other stokers have a chance to get their share.

Handling Ashes

Handling ashes is a tough job for any type of mechanical conveyor. Ashes are abrasive and usually corrosive. Lubrication of the internal bearings is impossible, and obviously a steel helix and trough cannot stand up on such a job. Usually the trough is made of white iron or hardened face concrete, with the helix of cast iron sections bolted together. The flights eventually grind to a thin edge at the periphery and break off, but so long as a suspicion of helix remains the ashes seem to move along somehow.

Since the helix must be in a straight line and cannot curve upward at the end of the run, there usually is a tandem bucket elevator. This circumstance sometimes leads to a preference for a slow speed drag chain conveyor with hardened face concrete trough, and hold-down wheel at the upturn. One good point as compared with the drag chain conveyor is that there is no dirt-strewing return run to provide for.

Figure 4 shows the coal handling capacity of various sizes of screw conveyors at the speeds noted at the left, in cubic feet per hour. This chart should not be used for ashes. The load factor with ashes should be much less, and the rpm should not exceed 40 or 50.

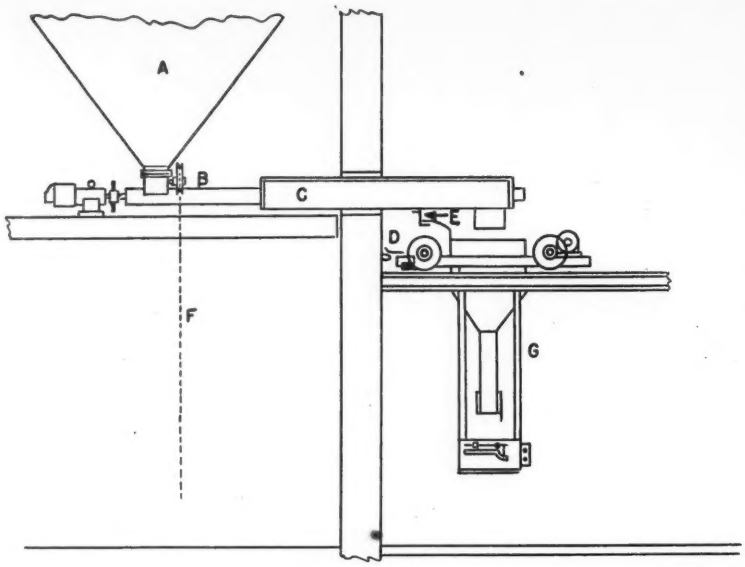


Fig. 3. Coal weighing layout

Estimating Power Requirements

The power requirement for horizontal screw conveyors handling coal may be approximated by the formula:

$$HP = \frac{C \times L \times 1.5W}{33{,}000}$$

where C = capacity of conveyor in cu ft per minute
L = conveyor length in feet
W = weight of material in lbs per cu ft (Usually 50)

The motor should be selected with a margin for drive loss, momentary overloads, and packing or setting of the material between runs. If the conveyor is inclined upward, allowance must be made for the power required to lift the material. If the power requirement is less than 2 hp the result obtained by the above formula should be multiplied by 2; if the requirement is between 2 and 4 hp the result must be multiplied by 1.5. When the conveyor is loaded directly from an overhead bin an allowance of ½ to 1 hp should be made. Example: We have a screw conveyor feeding 1½ x ½ in. slack coal from a bin to a stoker hopper 40 ft away. The capacity to be 10 tons per hour. Referring to Fig. 4, we can use a 12, 10, or 9 in. conveyor. In view of the size of lumps we will use the 12 in. screw, narrowing the pitch for the feed section receiving coal from the bin. A speed of 40 rpm is suggested. For power we have:

$$HP = \frac{6.7 \times 40 \times 1.5 \times 50}{33{,}000} = 0.7 \text{ hp approx.}$$

Since this is less than 2 we multiply by 2 and add 1 hp for the jam feed from the bin, making a total of 2.4 hp for which the nearest standard is a 3 hp motor.

Comments

The screw conveyor is easily maintained. The bearings should be provided with force feed lubrication so a collar of grease will be maintained at each end of the bearing. It is important that the alignment of the spindle be maintained closely, especially if the conveyor has considerable length. The spindle and trough are readily protected by a cover plate if the conveyor is exposed to the weather. Chunks of frozen coal, fragments of wood, roots, bags, waste, etc. will jam the helix and so the drive should be protected by shear pin. If the coal is corrosive the trough should be of cast iron and the spindle of copper-bearing steel or some other acid resistant metal.

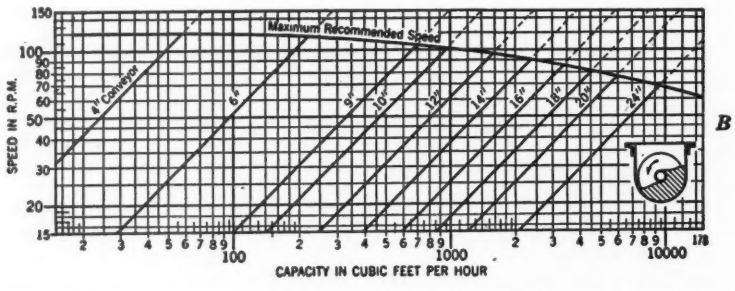


Fig. 4. Chart showing screw coal conveyor handling capacities in cubic feet per hour

To Improve Combustion

(Continued from page 71)

the steam chart during the 30-min "on" interval was in the form of a rough triangle. The pressure rose slowly, reached a peak, and then dropped almost straight down when the stoker stopped. During the 30-min "off" period the steam pressure was on the zero line.

The same coal with a 5 per cent admixture of activated fuel produced sharp changes in the chart. There was a sharp rise in steam pressure to a higher level soon after the stoker started and the pressure stayed up through much of the 30 min "on" period. A most interesting phenomenon in the furnace was observed. The coke trees rose to a certain point, then broke apart and mushroomed. During the 30-min "off" interval, the steam pressure did not drop sharply to zero, but continued slightly above zero until the stoker started again.

Effect on Coke Formation

Of course, the increased steaming effect is directly attributable to the breaking down of the coke. Although there was a decided increase in evaporation, the importance of the behavior of the coke formation may be said to far overshadow the data on economy. This feature should be of profound importance to builders of domestic stokers if the performance of activated coals is consistent with this test result.

Some tests of activated coal in the manufacture of packaged fuel have been made and, where high volatile coal was the base, considerable reduction in smoke was effected. Applied to anthracite briquets, an activated fuel base may increase the total fuel value and a controlled clinker is an objective.

New Approach a Challenge

Combustion engineers cannot help but look with interest on a new approach to an old problem. In fact, new thinking in coal technology is a challenge to the coal industry. Renewed activity by competitive fuels make an increase in the economic value of solid fuels imperative. Specific objectives may be summarized as follows:

1. Increase the heat content of coal; 2. Increase speed of ignition and burning rate; 3. Control the coking tendencies of bituminous coals; 4. Minimize or eliminate clinkering, or create the desired degree of clinkering so necessary in the domestic stoker and in the briquetting industries; 5. Make strip coals more widely marketable by improving their burning characteristics; 6. Increase the uniformity of individual coals.

If satisfactory progress is made in the activating process, this would seem to be a direct approach to attaining these objectives. Certainly it is a new and bold approach, appealing to the imagination.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Printed Electric Circuits

An interesting development in wiring practice which grew out of the perfection of the proximity fuse makes use of *printed* electric circuits. The method consists of printing circuit wiring, using silver resistor material on a plate and soldering small disk-like capacitors to the plate. Suitable masks are used to position the sprayed components. A carbon and resin mixture is used for the resistors. The result is the practical elimination of the third dimension from certain types of circuit wiring and the production of a subminiature compact form that can be produced at high speed without errors in wiring.

While this method of wiring can be used in small devices, such as miniature radios, hearing aids, and small electronic control circuits, plant electricians need not get excited over it. It is unlikely that their industrial plant circuits will ever be printed—they will still have to be put in the hard way. As a matter of fact this principle is not particularly new. Radio amateurs have used it for years. Quite early in "ham radio" it was discovered that a heavy black lead pencil mark made a good grid leak for detector circuit sand many amateurs used such pencil marks as grid leaks in their receivers. It is of considerable interest, however, to know that the method has been applied on a commercial scale and it is quite likely that for certain types of equipment it will prove valuable. The technique of this type of wiring was pioneered by the Centralab Division of Globe Union Inc. and is described in an article by A. S. Khouri and Cledo Brunetti of the U. S. Bureau of Standards Ordnance Development Division, that is to appear in the April issue of "Electronics"

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Peace—It's Wonderful

This is a sort of a sequel to an article written in November, 1941, a few weeks before Pearl Harbor. Like the first article this has nothing particularly to do with power plants or even engineering but it directs attention to some of the troubles in the world which are related to power and engineering. It continues to advocate taking "the Long View"

By ANDREW W. KRAMER

A LITTLE MORE than four years ago, in December, 1941, to be exact, I presented in these pages a short article discussing the broad aspects of the war in which we were, then, not yet engaged; for the article was written several weeks before Pearl Harbor. Those who read it may recall that I suggested taking a "long view" of the war, in fact that was the title I chose for the article. It may be recalled also that I placed the principle blame for the war, not on Hitler, not on Mussolini, not indeed upon any of the ordinary things which supposedly start wars, but upon the steam engine—upon the advent of mechanical power.

The steam engine brought about the huge concentrations of power which multiplied man's effort and which made it necessary for him to live in crowded cities. While the use of mechanical power created wealth it also brought slums and poverty among the exploited masses. The steam engine made it possible for some 1½ billion more people to live on this planet and that made it necessary that these people co-operate and live with each other in some sort of harmony. If they could not do this, they faced nothing but trouble and, in the end, annihilation.

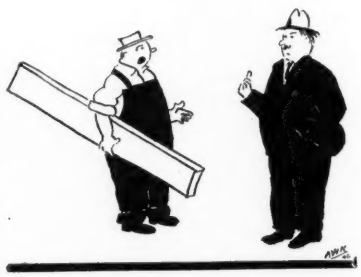
I also pointed out that the war would not solve our troubles—that, though it would end, as it eventually did, it would not materially change the course of human events. It was obvious at the time that two systems such as our democratic system and the national socialist system of Hitler, could not exist side by side, but it was clear, also, that regardless of which side was victorious, neither system would prevail in its entirety. These, in fact, were the exact words I used in 1941. The war finally did come to an end, a little sooner than many expected. So, now, we have peace. Peace—it's wonderful.

The Steam Engine is to blame

Hitler is gone; so is his pal Mussolini. So also are Goebbels and Himmler. Messrs. Goering, Hess, von Ribbentrop and all the other Nazi big shots are where they belong—in the clink at Nuremberg. The Russians are in Berlin, General MacArthur holds forth in Tokyo; Manila, the Pearl of the Orient, is a shambles just as is Warsaw, Naples and Nagasaki. The UNO is dickering for a site on which to erect a group of no-doubt monumental buildings somewhere in Connecticut and the U. S. Navy is making plans to see whether the so-called atom bomb is really all it is cracked up to be. In the meantime Russia walks out on the UNO. There is fighting in the Dutch East Indies, in British India and in the Near East. Peace—it's wonderful.

These things, however, are all far away from home. We don't have to worry too much about them; in fact, we have a few worries of our own. Just try to buy a white shirt. Do you remember the good old days when you used to go down to Joe's place, rap three times in a cabalistic manner, and then give the pass word before you could get a drink? Well, today, you use the same general technique in buying a shirt. The only difference is that in prohibition days you got a fairly good drink at only about double the value whereas, today, you get a perfectly lousy shirt for about four times what it is worth. During the war, women, if they could not get Nylons, could at least get some kind of stockings. Can they get any today? Ask the first girl you meet.

Well, maybe you don't need a shirt or you use leg makeup instead of stockings—all you need is a board to build a couple of shelves in your basement. So you go to the lumber yard and say, "I want a board about an inch thick and 15 feet long—just a plain pine board." The guy in charge of the place looks you over and after taking your finger prints and checking your financial rating in Dunn and Bradstreets snaps back,



Got the dough to pay for it, bub?

"Got the dough to pay for it, Bub?" The board, you find costs two bucks even. Before the war you got it for 40 cents. So you go back home and build your shelves out of grocery crates. Ah, Peace—it's wonderful.

But these things you may protest are, after all, trivial. What about the big things? Well, let's see. You are the owner of a factory and you want to get started on your post-war production. All you need is more electric power; you decide that now is the time to buy that new turbine you have been thinking about for five years. So you call up the E. G. Company and say, "Send me over a turbine and also a generator to hook on to it." "Swell," says the E. G. Company, "we are delighted with your order but just now our plant is tied up with strikes and it will be two years before we can even think about sending you a turbine." So you try the Eastinghouse Electric Corp. and curiously enough, they play the same record; they also are closed because of strikes.

So, whoever you are, you go home disgusted and resolve to relax and get one of those post-war dream radios you have been reading about in the ads for five years, one with tone color, exhalted carrier, amplitude, frequency and phase modulation and a built-in folded, rotatable dipole, whatever that is. But you find that the post-war radios are exactly like the ones you had five years ago except that you can't buy one yet: they'll take your order for possible delivery in 6 months to two years. Peace—it's wonderful.

In desperation, and to keep from going completely nuts, you finally decide what you need is a vacation in some nice warm place away from the worries and turmoil of the world. You proceed to the travel agency and

make hotel and travel reservations; that is, you start to make them. Mr. Foster, however, somewhat guiltily informs you that all the hotels are booked solid for six months and that the only train accommodations available are those in a box car, and anyway, there is a railroad strike on and you can't travel.

What Did You Expect?

Yes, peace is wonderful, but what did you expect? Did you think that the war could end and that, overnight, the world could suddenly become calm and stable? If anyone harbored such notions it proves that they had little knowledge of the fundamental forces underlying the war. As was pointed out in the article four years ago, the war was one manifestation of an evolutionary process that has been going on for a long time. It is natural that after such a violent phase of that evolutionary process, there should be serious dislocations of our social and economic structure. After all, it is too much to expect that we could blow the world apart and then put it together again and not have any cracks showing.

The cracks resulting from this war will remain for a long time. Some will close up, others may widen and give continued trouble. Just now, it may not be evident that the war accomplished anything but this may be because we are still too close to the picture to see its true pattern. We may not know what the war accomplished for a long time. All we know now is that it greatly accelerated invention and technical development. It gave us radar, accelerated industrial production, jet propulsion, automatic fire control, rocket projectiles, and finally, the atomic bomb. None of these things, however, are of help to us in solving our human, that is our social and economic problems; they only make them worse.

How many millions of people were killed during the war, nobody really knows; it doesn't matter as they will soon be forgotten. In wealth, the war is said to have cost 1400 billions of dollars—a lot of money in any man's language. How much of the world's resources were squandered—how much oil, iron, copper, tin, tungsten, etc., was wasted also will be difficult to determine but future generations will not praise us for our wantonness. Despite the cost in life and resources we still have our human problems. There is the same distrust and suspicion on the part of peoples, nations and races as existed before the war; there is the same intolerance of ideas and customs. We preach democracy and Christian principles but we close our eyes to the inequalities that exist all around us. We permit loyal Americans, though they be of Japanese descent and though they fought with valor and courage for our side, to be stoned and driven from their home and farms and places of business. Despite our disapproval of Nazi terrorism in Germany, anti-semitism is rampant in this country as elsewhere. All over the world there is bitter enmity between nations and races.

Again, as I tried to point out in my article four years ago, there is little that we, as individuals, can do about all this, except to keep our thinking straight. If we can do that and take the long view of things, perhaps some good will come out of it all. H. G. Wells does not think so. He feels that the world has grown too complex for us to handle; that the technical development has so far outstripped our moral, social and cultural development that the former will destroy us before the latter can catch up. He may be right. There is enough intelligence in the world capable of solving all our problems for the good of every one but the forces of ignorance are so great that with the time at our disposal, there seems little hope that they will be solved. There is little tendency on the part of those who could do something, to learn by experience. There is a quotation from T. E. Lawrence in Charles G. Bolte's recent book, "The New Veteran," that seems appropriate here. It runs as follows:

"We lived many lives in those whirling campaigns, never sparing ourselves any good or evil; yet when we had achieved, and the new world dawned, the old men came out again, and took from us our victory and remade it in the likeliness of the former world they knew. Youth could win, but had not learned to keep, and was pitiably weak against age. We stammered that we had worked for a new heaven and a new earth, and they thanked us kindly, and made their peace. When we are their age, no doubt we shall serve our children so."

Basically, there is only one hope for the world and that lies in education—something we have never really tried. If the children of all countries, all over the world, could be given a uniform course of instruction, based on tolerance, kindness and fairness, if all ideas of race superiority and national pride could be wiped out, if religion could be taught as a way of life, not as a set of principles belonging to a particular church, then perhaps, in a few generations this might begin to be a better world. Until all

"They're from somewhere in the So. Pacific—they said you told them to look you up if they ever got in your neck of the woods."

You can't blow the world apart and then put it back together again and have no cracks showing

the diverse peoples on this planet are welded inseparably into one great economic and social union, there can be no hope of lasting peace.

Man's Emphasis on Numbers

Among the strange and curious notions that have made this world so intolerable, is man's insane emphasis upon numbers; upon more production, more population, increased exploitation of our resources. Just now, in these United States, the statisticians are predicting, with obvious glee, a population of 200,000,000. In the western states there are movements afoot to industrialize the west so that more people can live there. Why should any more people live in the west? The great charm of the west has been due to the fact that so few people have lived there. It seems to me that this country was a better place when it had a population of 80 million than at present with its 140 million. Granted that the machine age makes it possible for more people to live in a given area, does that make living any better? What we need is not more people but fewer, better people.

Dr. Logan Clendenning pointed out that the human organism is fitted for the performance of only two main functions, 1, the conversion of food and air into energy and tissue and 2, the reproduction of other individuals of its species. Unchecked, the organism reproduces until its consumption balances the available food supply. If reproduction tends to continue beyond this point famine acts as a check. This is the condition that has prevailed in India and China for centuries.

We of the western world do not subscribe to this method of population control; we are intelligent and very sentimental when it comes to letting people starve to death. We prefer to kill them by blowing them to pieces with high explosives or burning them with flame throwers and other clever civilized gadgets. We don't believe in famine but we still insist upon populating every square mile of the planet's surface with people. Many of our most valuable resources have already been depleted to the point where we are beginning to notice their scarcity but we still go on demanding increased production. To what end? If, as the bank ads tell us, a sizable bank balance provides one with a sense of security and comfort, why should not a reasonable balance of oil, coal, iron and copper in the ground also give nations a sense of security and comfort? But, no; in the case of our natural resources we must get them out of the ground and squander them as quickly as possible.

The Almost Perfect State

I have sometimes thought that perhaps it might be a good thing if all our coal and oil and most of our mineral resources were exhausted tomorrow. Then, there would be nothing serious to fight about and little to fight with. There would be less people. Don Marquis, in his whimsical, half serious, half humorous book "The Almost Perfect State" points out that in the Almost Perfect State there will be no coal strikes because no one will use any coal. The population of North America, he says, from the Pole to the Isthmus of Panama, will be only about three million. These people will have their permanent dwellings along the coasts of the sea, the shores of the lakes and the large rivers. The country will be reforested and will abound in game of all sorts. People will live from the game they kill and from agriculture. There will be very little commerce and industry. The abundant leisure of the population will be devoted to playing, making love, producing works of art and arguing about religion.

People will burn wood instead of coal because wood smells better when it is burning. That, says Don Marquis, is enough reason to abolish all the coal mines and every industry dependent upon coal. Everything, however, will smell right in The Almost Perfect State; there will be much to gladden the eye and nothing to lacerate it—in short a hell of a lot of fun all around.

There is more good sense in Don Marquis' plan than his easy and humorous manner of writing appears to indicate. His is a plea for simplicity, for an easier way of life. What man has always wanted is more fun all around and less work and worry. He will not get this by devising bigger and better atomic bombs or flame throwers and even television sets. He will only get it by education, by improving himself mentally and spiritually, and by adopting a simpler way of life. It may take a few thousand centuries to bring this about but it is worth working for. In the meantime, as Marquis points out, "be as good as you can individually, person to person" and don't lose your shirt at every rumor of going to war with Russia. Remember it is hard to get a new one, I mean, a new shirt.

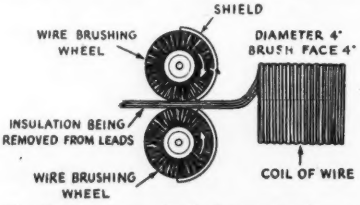
PRACTICAL HINTS AND KINKS

Power Brushing Removes Insulation

POWER BRUSHING of lead wires on heavy industrial motors to remove formex without changing the cross-section of the wire has been found to be faster and better than any other method previously used, according to a report received from The General Electric Co. by the Osborn Manufacturing Co., of Cleveland, Ohio, world's largest manufacturer of power brushes.

The report described an operation in which the insulation is removed from the lead wires of from 50 to 150 coils which are part of the stator field of these 10- to 40-horsepower motors. By using the Osborn power brush of the 4-inch "Monitor Section" type, it is practical to feed the wires into the brushes from four to eight at a time. Usually, one application completes the enamel removal, although occasionally they must be put through a second time.

Two brushes are used in this operation (see sketch), operated from a one-half horsepower motor revolving at a speed of 1,700 revolutions per minute. The wires are applied to the brushes by hand. Average life of the brush, equipped with .0104 wire, is estimated at 60 hours.

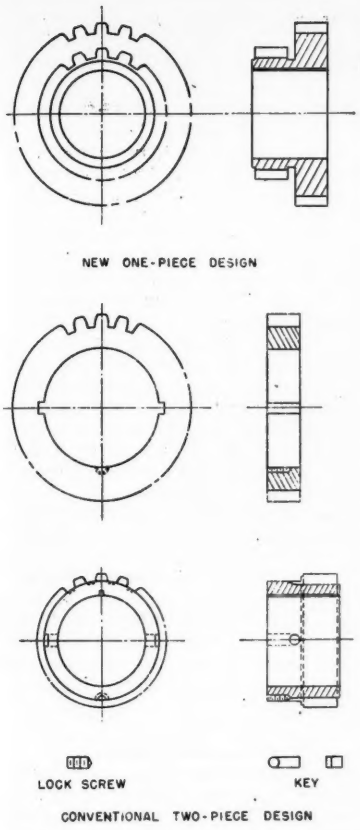


Sketch showing method of removing formex insulation from the lead coil wires on induction motors. The wires, four to eight at a time, are fed to the two 4-inch Monitor section power brushes

Double Spur Gears From One Piece of Stock

A METHOD of cutting double spur gears from one piece of stock was developed by Paul Chapman of the Gear Cutting Division at General Electric's Pittsfield Works. The adoption of this one-piece design has eliminated the conventional method of cutting the gears from two separate parts and joining them by means of locking screws and keys.

Not only has the assembly of the two pieces been eliminated, but the



Double spur gears from one piece of stock

slow hobbing operation of the second piece is no longer necessary since both gears are now shaped during the cutting operation. The new one-piece design is stronger than the assembled gears, and much of the machining has been eliminated.

The suggested design has reduced production time of the double spur gears by approximately 38 per cent.

Raising a Smokestack with a Makeshift Winch

By H. B. McDERMID

He was only the driver of a dray but he was resourceful and he used his head

A SHEET METAL contractor got an order for the rush fabrication and erection of a small smoke stack for a saw mill in a backwoods town, and after making it up, shipped it to the site, in charge of the driver of a horse drawn dray, completely ready for erection.

On arrival at the customer's plant, the driver of the dray found the owner of the plant in a tremendous hurry to get back into production, and asking him if there was no way he could hurry the erection of the stack. The driver was a resourceful fellow, and besides had been raised in the old school where men were both ingenuous and accommodating; found some rope and a block and a few men and volunteered to do the job at once, though the contractor's plan was to do the erecting later.

His improvised rig showed both skill and ingenuity; first, he took some men to the nearby woods and selected a gin pole fit for his purpose, which he set up and guyed near the foundation of the stack. Then with the available set of blocks, attached to the stack in a balanced hitch, he got power for his hoist by running his load line through a snatch block anchored near the ground, thence out to his high wheeled dray, which he fastened in place solidly. Then, jacking up one hind wheel of the dray he placed two steady men at its rim to furnish power, while another wrapped the load line around the hub and kept it tight, thus making a fair to middling winch out of it. Then with two tag lines attached one on either side of the stack, near the bottom end and the permanent guys attached at their upper ends to the stack, he was ready to hoist. The leverage proved ample for the weight, so he hauled it up till the stack was high enough, so he could put a light pressure on the tag lines and so pull the balanced stack from its level position to a practically vertical one and lower away till the stack stood on its foundation.

Some juggling of the gin pole guy lines was of course necessary for proper spotting, but with reasonable care that was easy; there then remained only the permanent fastening of the stack's steel guy lines, and he was ready to let down his gin pole. This he did by now using the anchored stack as his temporary gin pole, and after slacking off all the gin pole guy lines, lowered the pole to the ground merely by paying off the rope block just used for the hoist. The only high work now was taking off the hitch half way up the stack which was accomplished from a ladder.

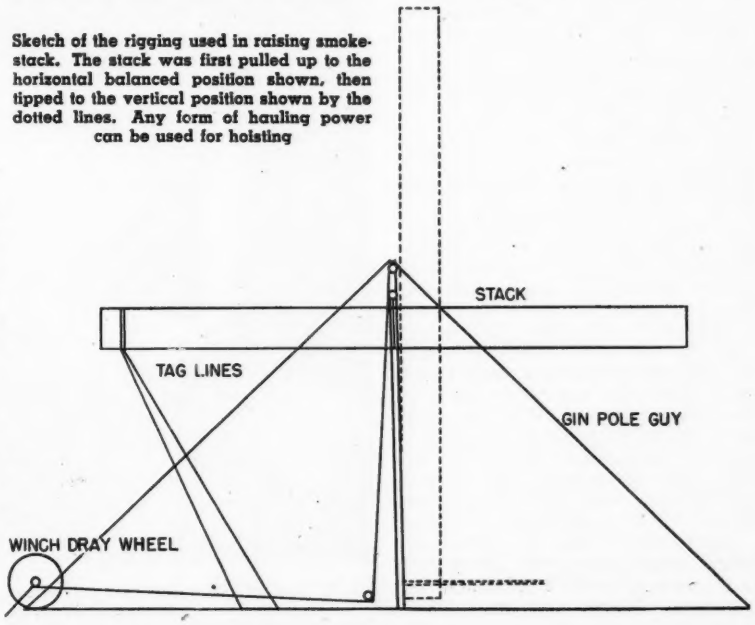
So the job was complete in very short time, to the great satisfaction of the customer and contractor; the latter was much surprised as well as pleased, when he found that no erecting crew was necessary.

The sketches show how the rigging was applied, and are practically self explanatory. An improvement to the balanced weight plan could be easily used, permitting a smaller and shorter gin pole to be applied, and eliminating some of the high climbing. If the stack were picked up at a point lower than the balance, and a set of falls attached to the bottom, so it could be upended when hoisted high enough, neither the gin pole nor the final cutting loose of the hitch would have to be so high above the ground. Good head work in the application of hitches is essential so that they pull in line as wanted, as that helps immensely in such a job, as in most other rigging—where good brains in the boss's head are the most valuable item on the job.

The method outlined above, can be used to advantage in the placing of many long heavy objects, such as a flag pole, a heavy gin pole, or small tower, where there are no nearby objects from which to get a high direct hitch.

AMONG THE really large units in power plants is the condenser installed in the Richmond power station of the Philadelphia Electric Co. which is 44 ft long, 29 ft wide and 32 ft high. About the size of an ordinary seven-room house. This unit, built by Westinghouse, requires for its operation almost three times the amount of water used in a day by a city the size of Philadelphia — 219 million gallons—when it is operated at full capacity.

Sketch of the rigging used in raising smokestack. The stack was first pulled up to the horizontal balanced position shown, then tipped to the vertical position shown by the dotted lines. Any form of hauling power can be used for hoisting



The Boiler Fireman's Handbook

By J. R. DARNELL

Kinds of Fuels . . . The Unit or Direct Firing System . . . Pulverized Fuel Firing with Small Boilers . . . Furnace Design and Its Relationship to Heat Release . . . Preparation of Pulverized Coal . . . Grindability and Fineness . . . Firing Methods . . . Operation of Burners

Part XX—Pulverized Fuel Firing

THERE ARE TWO basic systems of pulverized fuel preparation and firing. The first, the bin system, requires a greater initial investment and greater floor space, although it does have certain advantages not found in the unit system. Proponents of the latter system, however, argue that its advantages outweigh those of the bin system. Space does not permit a detailed comparison of the two systems, and since it is generally agreed that the unit system can be more readily adapted to small plants, we will confine ourselves to a discussion of this system.

Kinds of Fuels

Bituminous coals, tar pitch and petroleum coal are the principal fuels pulverized in this type of firing. Bituminous coals are used to a greater extent than any other kind of fuel. Combustion efficiency tables and curves for various kinds of coals may be found in Chapter VII (February, 1945).

The Unit or Direct Firing System

In contrast to the bin system, the unit or direct firing system does not require drying the coal before feeding it to the mill. In the unit system the raw coal is fed to the mill preferably from an overhead bunker, although it has been shoveled by hand from the floor to the hopper of the mill. Figure 1 shows two such units installed under HRT boilers which were formerly hand fired. In many cases the chief difficulty in adapting pulverized fuel firing to hand fired or even stoker fired units is lack of sufficient combustion space to permit the necessary turbulence and resultant greater heat release inherent in pulverized coal firing. If a new boiler is to be installed with pulverized fuel firing, provision can and should be made for adequate combustion with water cooled walls. In converting old boilers to this type of firing, in some cases the boiler can be raised, or if this is impractical, removing the grates and lowering the ash pit will provide the necessary combustion space.

Today, after almost 5 years of excessive usage during the war period and generally with a minimum replacement of parts, many small boiler plants are faced with the serious problem of installing new boilers and firing equipment or revamping their old units.

Although the United States still has huge reserves of both coal and oil sufficient to last for several hundred years, equitable distribution of these fuels often is disturbed by such unforeseen events as strikes, floods, car shortages, etc. Considering such possibilities, a wise plant owner or manager should design his boiler furnaces so that they are flexible enough to utilize different kinds of fuels. But in many small plants the owner or manager knowing little or nothing about fuels and combustion, turns to the plant engineer or fire man or both, for advice. In such cases, it will be extremely advantageous for the ambitious fireman to have prepared himself to discuss intelligently the advantages of pulverized fuel firing, particularly when installed in combination with gas and oil firing.

Pulverized Fuel Firing with Small Boilers

1. Firing HRT Boilers

One of the smallest pulverized coal firing units ever installed is shown in Fig. 2. The boiler is of the HRT type, 72 in. in diameter by 18 ft long. The pulverizer is rated at 700 lb coal per hour and is driven by a 7½ hp totally enclosed fan cooled motor running at 3450 rpm. The unit was designed to develop a maximum capacity of 140 per cent of boiler rating. Eastern bituminous coal of approximately the same quality shown in Table II and Fig. 2 of Chapter VII, is fired. Figure 3 is a front view of the coal hopper and shows coal being fed to the hopper from an outside bunker by means of a vertically sliding gate.

This boiler and furnace has been operated at about 80 per cent efficiency at all loads.

Figure 4 is a side elevation of another HRT boiler equipped with a unit pulverizer operating at about 200 per cent rated capacity. In this installation the ash pit was lowered 2 ft to provide greater combustion space.

2. Firing Water Tube Boilers

Unit pulverizers are even more adaptable to firing water tube boilers than the HRT type since, in most cases, the water tube type are provided with greater combustion space in proportion to the quantity of steam to be generated.

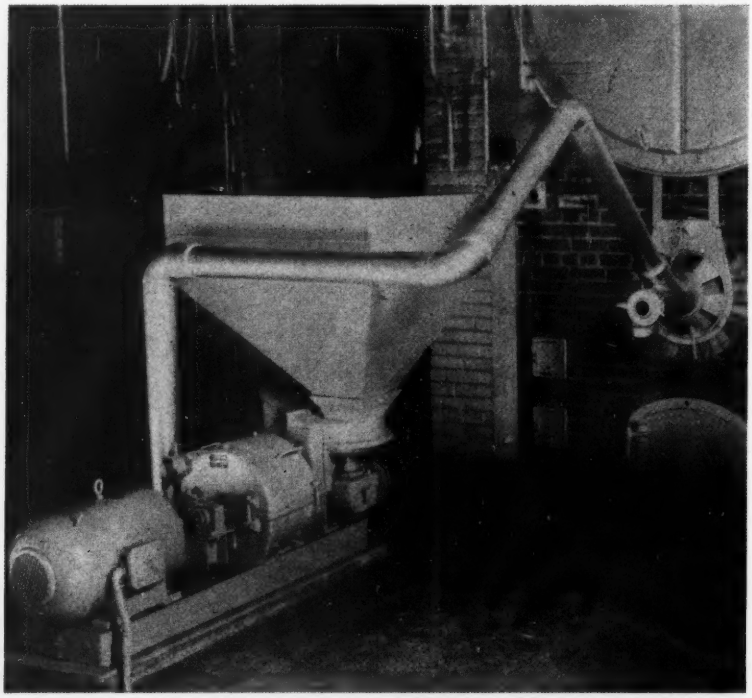


Fig. 1. One of two small unit pulverizers supplying pulverized coal to natural draft burners under 72 in. by 18 ft HRT boilers

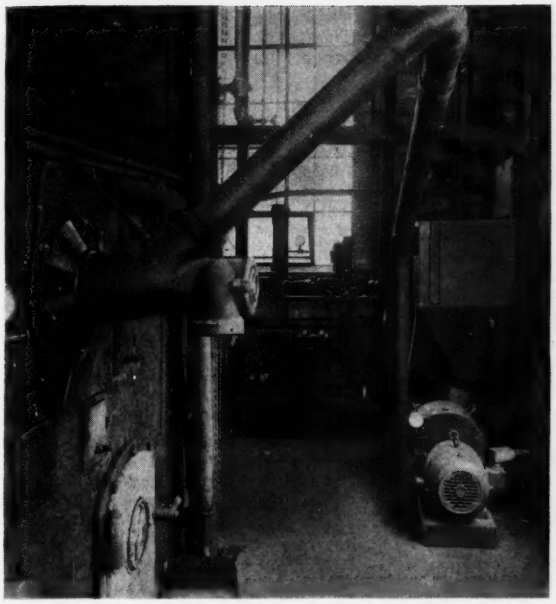


Fig. 2. This is another small unit pulverizer and natural draft burner firing an HRT type boiler at 80 per cent efficiency at all loads

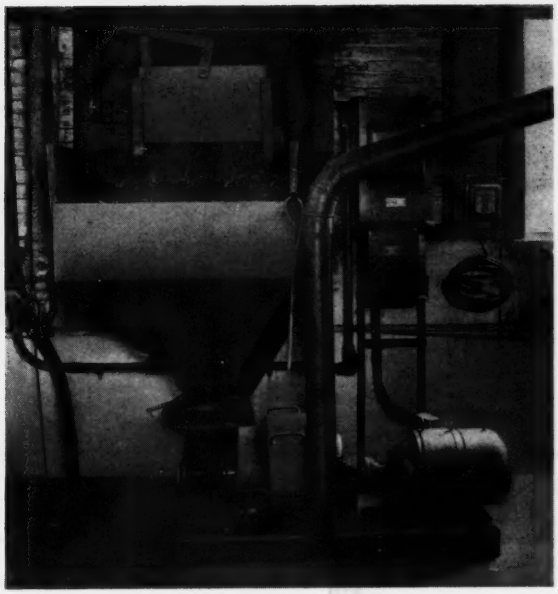


Fig. 3. Here is a front elevation of the pulverizer shown in Fig. 2

In Fig. 5 is shown the application of a unit pulverizer to two-160 hp water tube boilers which had been fired with oil. The maximum capacity of these boilers is now about 160 per cent of rating. In order to supply the burner of each boiler with pulverized coal, a splitter valve was provided in the main pipe directly above the pulverizer unit so that the coal was divided into two streams.

Referring again to Fig. 5 it should be noted that the level of the furnace floor when oil firing was lowered about 4½ ft for pulverized coal firing. Although the weight of products of combustion per pound of fuel for the same percentage of excess air is less with coal firing than for oil firing, with pulverized coal a larger combustion space should be supplied in order to effect an intimate mixture of air and products of combustion and to consummate to the fullest extent, the turbulence effected by the rotative movement of coal and air passing through the burner.

Furnace Design and Its Relationship to Heat Release

Although the furnace design, i.e., its length, volume and type of wall construction presents several complex problems when considering the greatest amount of heat release permissible with a given kind of coal, the boiler fireman should be advised that if he is firing midwestern coal with 11,000 Btu per lb and 13 per cent ash having a fusion point of about 2300 F, he must not expect as great a heat release as when firing a good grade of Eastern bituminous coal with 14,000 Btu per lb and 6 per cent ash with a fusion point of 2600 F. In other words, if he does not have water cooled furnace walls he must not expect to "fire the furnace as hard" with poor coal as with good coal.

With most reconverted installations of pulverized coal firing, regardless of the size of the boiler, and even in many new installations with small boilers, the initial investment for water walls is prohibitive. Most small plants, therefore, operate either with solid refractory walls or air-cooled refractory walls. With the latter type of wall construction the forced draft fan must deliver sufficient volume and pressure to adequately cool the walls and prevent fusion of the ash. If this is not done, heat releases no higher than with solid refractories may be expected.

When firing low grade coals having ash with a fusion point of about 2000 F, if solid refractory walls are used, the fireman should not attempt to obtain a heat release over 10,000 Btu per cu ft of furnace volume. For example, referring to the furnace of Fig. 4, the volume of the combustion space is about 1100 cu ft. If the above low grade coal of 9000 Btu per lb is fired with 70 per cent efficiency and the heat release should be held at 10,000 Btu per cu ft of furnace volume, the total heat release should be about 9,900,000 Btu. Since the heat available from each pound of coal is 6300 Btu, by dividing 9,900,000 by 6300 we obtain approximately 1570 lb coal per hour. This is the maximum amount of coal of such grade which should be fired in a furnace of such size and wall construction.

In Fig. 6 the curve shows an approximate relationship between the permissible heat release and the fusion point of coal ash when the furnace walls are constructed of solid refractory. From 1850 to 2500 F fusion points for the ash, the curve is

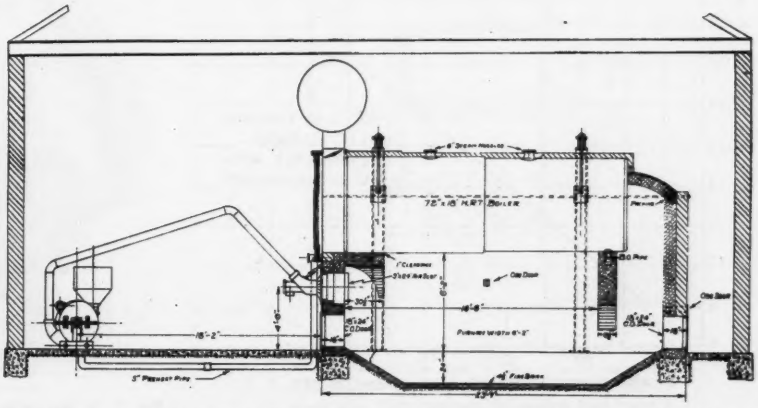


Fig. 4. This side elevation of an HRT boiler and furnace shows how a unit pulverizer similar to that in Figs. 2 and 3 was installed

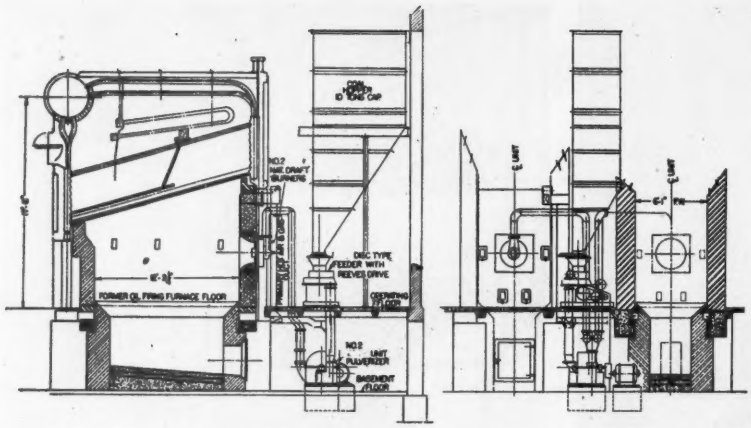


Fig. 5. Two 160 hp oil fired boilers were converted to pulverized coal using a single unit pulverizer

straight line. Above 2500 F, certain observers claim that even though coal with ash of a higher fusion point is fired, higher rates of heat release are not permissible because the flames would infringe on the walls and cause slag formation. This curve is probably sufficiently accurate for the average furnace with horizontal firing so that it may serve as a rough guide for firing the maximum amount of coal per hour without excessive refractory maintenance.

Preparation of Pulverized Fuel

Mills for grinding and pulverizing coal may be classed as:

Contact or Roller Mills
Tube and Ball Mills
Impact Mills
Attrition Mills

There are numerous makes of each of these classes but space does not permit any detailed description of any of these types. Figure 7 illustrates one type of roller mill in which the coal is fed into the center of a revolving bowl, the centrifugal action causing the coal to be thrown into the path of the rollers.

Figure 8 shows a type of ball mill in which the coal is fed to the mill (at a point not shown in the broken away section) and ground to the proper fineness by rotating balls.

The mill shown in Fig. 9 combines both the impact and attrition methods of coal grinding. The lumps of raw coal are first broken up by swinging hammers and the particles then carried by air into the second chamber which consists of alternate rows of moving and stationary pegs. The moving pegs fastened on a rotating disc, travel between the stationary pegs which are fastened to the housing. This reduces the coal particles to the proper fineness.

All of the various types of mills are provided with means for rejecting pieces of iron (tramp iron) or other metals which are often found in the raw coal. Likewise, all types are provided with means, called classifiers, which separate the coarser particles of coal from the fines and return the coarse particles to the mill for further grinding.

Grindability and Fineness

Much has been written about the "grindability" of various coals and with various mills. By grindability is meant the ease or difficulty encountered in grinding the coal to a given fineness. Fineness usually is rated on the basis of the percentage of coal passing through a 200 mesh sieve. Most manufacturers of pulverizer equipment specify not less than 65 per cent through such a sieve and prefer a fineness of 70 to 80 per cent. Economy, however, is an important factor in determining the maximum degree of fineness to which a particular coal should be ground. Some coals may have such a low grindability factor that it would not pay to grind to a fineness of more than, say, 60 per cent. If it is found that a particular mill is not grinding the coal fine enough to produce as high a CO_2 value and furnace temperature as the fireman believes should be obtained, steps should be taken to determine whether it will pay to grind the coal finer, at an increased cost of power, and perhaps, an increased cost for a different grade of coal, or suffer a loss in efficiency with lower CO_2.

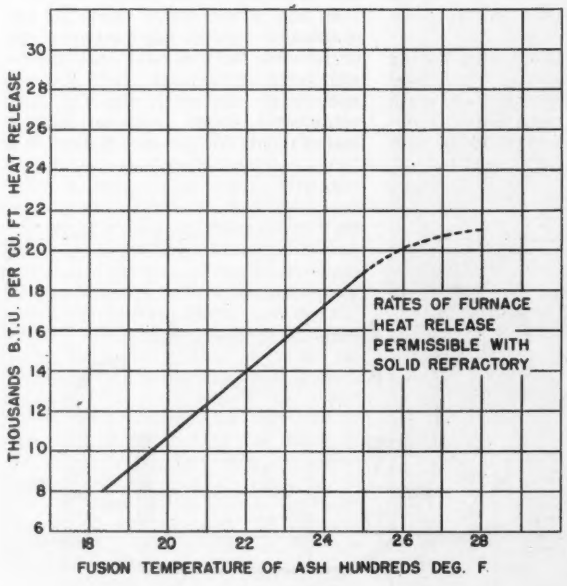


Fig. 6. This curve shows rates of permissible heat release at various fusion temperatures of ash with solid refractory walls

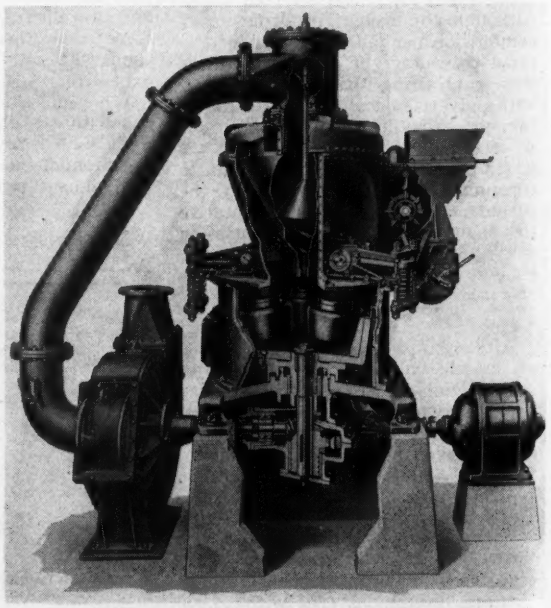


Fig. 7. In this roller mill, coal is fed into the center of a revolving bowl. Centrifugal action causes the coal to be thrown into the path of the rollers (Combustion Engineering Co.)

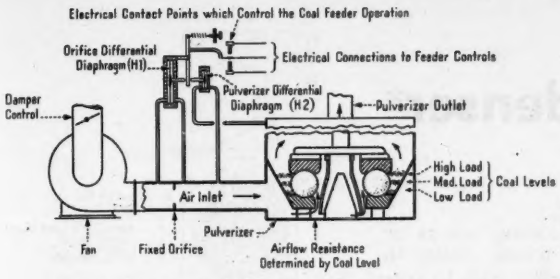


Fig. 8. This is a ball type of mill for pulverizing coal

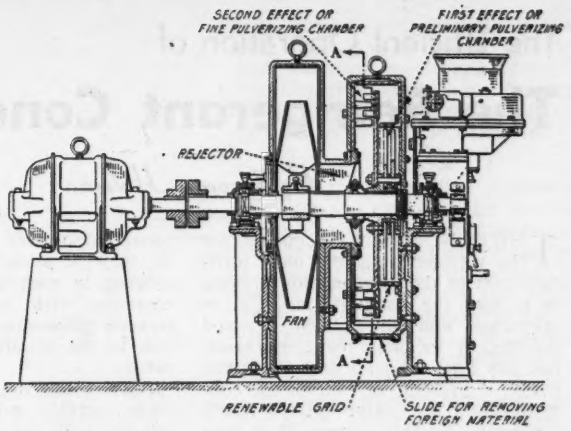


Fig. 9. (Right) In this type of mill coal is pulverized in the first stage by impact and in the second stage by attrition

Firing Methods

Pulverized fuel burners are installed in three different planes, depending on the type of boiler, the available combustion space and the kind of burner. The direction of firing may be classified as either:

1. Horizontal
2. Vertical
3. Tangential

In many instances, burners are of the combination type and are designed to burn either pulverized fuel, oil, or gas or all three fuels simultaneously. Figure 10 illustrates such a type of burner.

Figure 11 is a cross sectional elevation of a pulverized fuel-burner having the nozzle located in the center of the air housing. Coal entering at A is discharged into the furnace through the annular space between pipes C and F. At, or near, the point of discharge the coal is diffused by a series of radial blades E which impart a special motion to the stream of primary air and coal. Blades E are adjustable with reference to the burner nozzle by pulling pipe F in or out and then locking it in position by screw H. Such adjustment will affect the length and flare of the flame.

Secondary air is admitted to the air housing through dampers M and is then evenly distributed around nozzle C by vanes K, the axis of which are parallel with the axis of nozzle C.

Operation of Burners

One of the most important points to observe in starting a pulverized fuel burner is to be sure that a burning torch is placed inside of the furnace before any coal is blown into the furnace. Pulverized coal when mixed with the proper amount of air is as explosive as gas or oil. After the coal has been started feeding into the mill, the primary air pressure should be kept low—4 to 6 in. water gage. If the air pressure is too high the coal flame will be blown out. After the coal has ignited, the air pressure and amount of coal should be gradually increased. If the boiler has more than two burners the center burner should be lighted first.

The furnace should be provided with adequate observation ports so that the fireman can observe the action of the burner flame and so regulate it that there is no impingement on the tubes. If the flame is too long and smoky the air supply must be increased or the fuel supply reduced. In general, the regulation of pulverized coal burners is similar to that with oil firing.

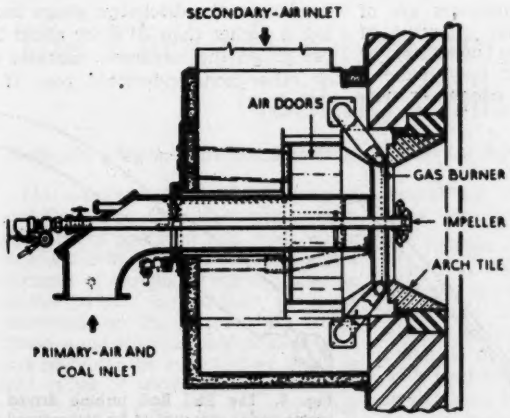


Fig. 10. This combination burner may be used for pulverized coal, oil or gas or any of these fuels separately

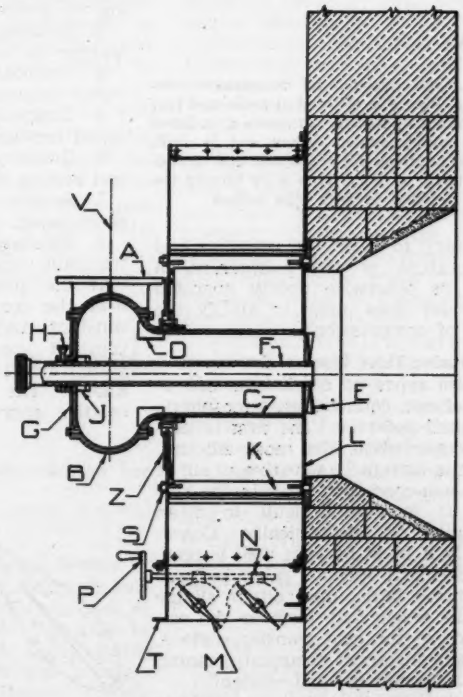


Fig. 11. In this burner the curved radial blades at the end of the nozzle may be adjusted by moving the supporting rod in or out. This controls the length and spread of the flame

The Efficient Operation of
The Refrigerant Condenser*

By George Holman

THE CONDENSING equipment for the refrigerant is the most intricate part of the refrigeration system. It is also the costliest, initially, in operation and in upkeep. Viewed broadly, it includes the compressor, hot gas line, oil trap and automatic purge, if present, as well as the condenser and the water system which serves it. All this equipment is centralized at the condenser, however, for it is through the metal walls of this vessel that the heat absorbed in the evaporator is expelled from the system. Though the compressor is necessary to raise the pressure and temperature of the refrigerant, a dirty or otherwise poorly operated condenser does much to nullify the work of compression.

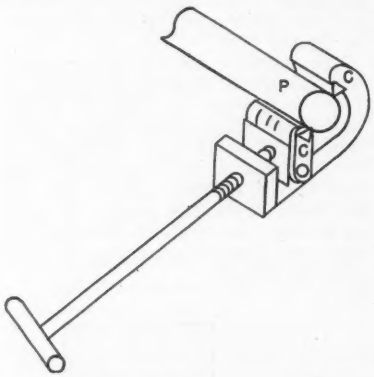


Fig. 1. Pipe descaler for atmospheric condenser. Pipe P is cleaned of scale and rust by manual operation. Scrapers c, c, have three cutting edges. When one is dull, scraper is driven out of the slot, and turned. Adjustment to fit the pipe is by turning the handle, as with pipe cutters

Cleaning Three Types of Condensers

Three types of condensers are in general use: counterflow, atmospheric and shell-and-tube. The first is usually regarded as the most efficient. But it is extremely sensitive to air or other non-condensible gas in the system. It is also difficult to clean manually or mechanically. Consequently it must be kept well purged, and chemical solvents must be used to remove scale, dirt, oil or sludge deposits which may form on the water side of the heat transfer surface. In many instances chemical cleaning is both economical and efficient.

In shell-and-tube and atmospheric condensers chemical cleaning is also satisfactory. This is especially true of plants where condensing water is recirculated over cooling towers or by way of spray ponds. Solids in solution in such waters tend to concentrate, with scale-forming substances increasing in direct proportion to the amount of water evaporated.

Some solids deposited on tubes or pipes, notably solids of a clay-like nature, will not dissolve in strong alkaline solvents or in acids strong enough to attack metal. In such cases, manual or mechanical cleaning methods must be resorted to. Some descaling utensils for this purpose are shown in Fig. 1, 2 and 4. Fig. 1 is that of a descaler for the outside of atmospheric condenser pipes. Figure 2 shows descalers for the internal surfaces of tubes or pipes. Figure 4 is that of a small water-driven turbine used for cleaning tubes internally.

Factors in Determining Performance

To correctly determine condenser performance the following factors should be known:

1. Temperature of the water entering the condenser.
2. Temperature of the water leaving the condenser.
3. Quantity of water entering and leaving the condenser.
4. Temperature of the refrigerant vapor entering the condenser.
5. Temperature of the refrigerant liquid leaving the condenser.
6. Quantity of refrigerant entering and leaving the condenser.
7. Suction pressure of the refrigerant vapor.
8. Discharge pressure of the refrigerant vapor.

If the quantity of water flowing over the condenser is known to be constant, and if compressors are of constant speed, actual quantity of water and refrigerant need not be known. The operator may make a relative appraisal of condenser performance from the other six factors as follows:

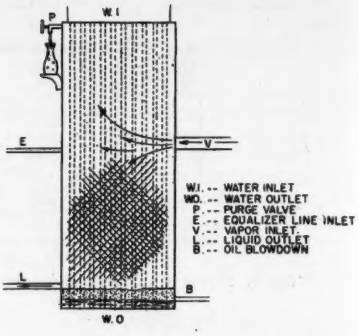


Fig. 3. Air in a refrigeration system tends to collect in the condenser. During operation of a shell-and-tube (vertical) condenser, this air becomes cooled by the condensing water. Being thus heavier than the incoming hot vapor from the compressor, it sinks toward the bottom of the condenser, and collects (in the cross-hatched area) just above the liquid. After compressor has been idle for a while, however, diffusion sets in. Shortly after an equilibrium of temperature is reached throughout the condenser, there will be as much air at the purge valve near the top as above the liquid at the bottom

Case A. If the suction pressure rises, the temperature differential between the water entering and leaving the condenser should increase. For example, if the pressure indicated on the suction gauge rises from 15 psi to 30 psi, a normal differential of 4 degrees might be expected to rise to 6 degrees. This would be no fault of the condenser, but due only to the increased load placed upon it.

Case B. If the suction pressure should fall from 15 psi to 10 psi, the water temperature differential across the condenser might be expected to fall from 4 psi to little more than 3 psi.

Case C. If with no compressors running, and with water at constant temperature of 70 F flowing over the condenser, the discharge gauge reading is higher than 70 F, or about 115 psi gauge, the condenser contains air or other non-condensible gas. If in

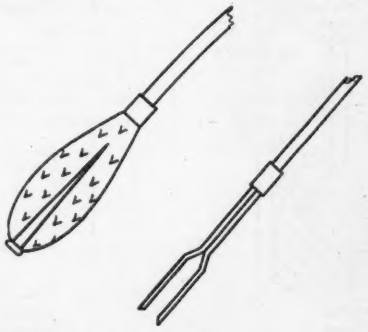


Fig. 2. Types of manual tube cleaners for shell-and-tube condensers

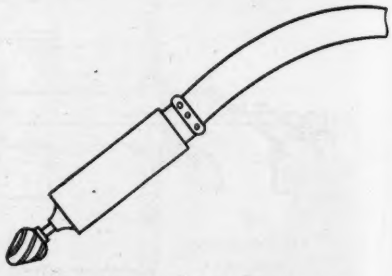


Fig. 4. The Phil Ball turbine driven by water under pressure or by compressed air, using knockers for hard scale and brushes for soft scale, is the most effective mechanical method of cleaning the inside of tubes or pipes

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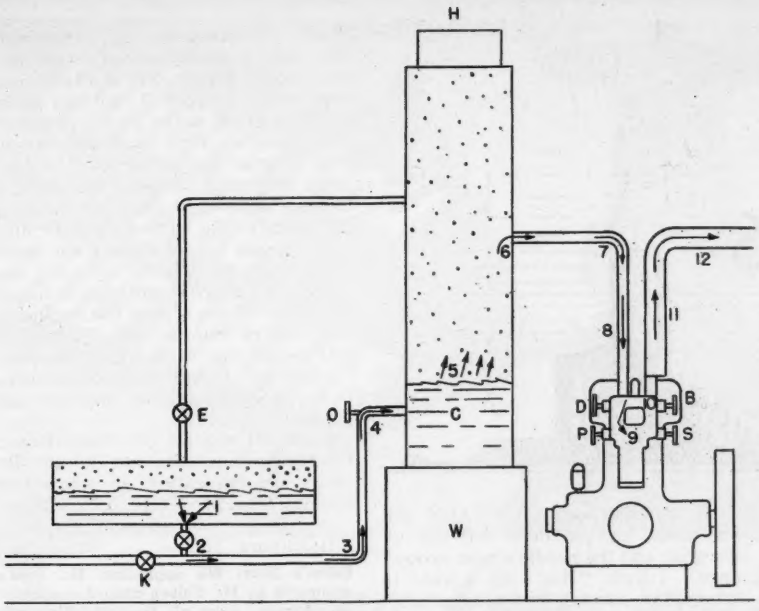

Fig. 5. Pumping Out the Liquid Receiver Through the Condenser
Should it ever become necessary to quickly pump out the liquid through the condenser, the following procedure should be strictly adhered to:

1. Close king valve K
2. Close equalizer valve E
3. Stop compressor
4. Close discharge valve D
5. Close suction valve S
6. Open by-pass valve B
7. Open pumpout valve P
8. Start compressor
9. Keep water running

Vapor pressure in the condenser will fall rapidly, but pressure of vapor in the vapor space of the receiver cannot fall, due to the closed equalizer valve without pushing the liquid and condenser outlet valve O and into the lower part of the condenser. This is what happens. Water should be kept running through the condenser. If the hot gas line is short, the pumpout valve P should be kept throttled to protect the compressor from a boil-over from the condenser. While the condenser serves as an evaporator, and water the fluid being cooled, the refrigerant follows the path of the arrows from 1-12 into the evaporators

excess of 2 psi, purging should be resorted to.

Case D. In normal operation, the temperature indicated by the discharge gauge is always somewhat higher than that of the liquid of the refrigerant leaving the condenser. If this difference should become more pronounced, it would indicate that the system was overcharged with refrigerant, and that liquid was submerging a perceptible part of the heat transfer surface.

Case E. Temperature of the liquid refrigerant leaving the condenser is always slightly higher than the temperature of the water leaving the condenser. Should this difference increase, condenser surfaces are becoming scaled or dirty, and should be cleaned.

Case F. Should there be a decrease in the water temperature differential across the condenser, which could not be accounted for by a drop in suction pressure, and especially if water temperature increases or if more water must be used, transfer surfaces are becoming dirty, and must be cleaned.

The Care of Hot Water Tanks and Heating Coils

Notes on proper maintenance from the Water Service Laboratories, Inc.

HOT WATER tanks should be drained and flushed at least once per year to rid them of sediment and mud. While city water is pure, it contains slight amounts of suspended silt and organic matter which accumulate in large quantities on the bottoms of tanks. These impurities as well as loose rust and scale can be removed by flushing with a jet of water from a hose, or with the aid of an ordinary scrubbing brush. Where steam coils are used in the tank, the deposition of sediment and microscopic plant growths may so retard the heat transmission as to necessitate more frequent cleaning than once per year.

Tankless and Submerged Heaters

In a system using tankless or submerged heaters, deposit formed on the inside surfaces of the coils by algae, sediment, and scale-forming minerals in the water also interfere with heat transfer. Much of this difficulty can be avoided by provision for regularly back-flushing the coils with cold water.

In hard water districts the calcium (lime) salts deposited in the coils not only interfere with the heating of the water, but greatly restrict the flow. Such coils can be cleaned by removing them from the boiler and sending them to a properly equipped laboratory for inhibited acid treatment.

Insulation

A loss that sometimes escapes attention is the heat emission from uncovered hot water tanks and pipes. A section of 3 in. pipe whose temperature is 100 deg. higher than the surrounding air, will lose heat equivalent to 7½ tons of anthracite coal per year per 100 ft of pipe. The loss from 100 ft of 2 in. pipe is at the rate of 5 tons of coal per year.

The heat emission from uncovered iron tanks, under the same temperature conditions as above will be 215 Btu per hour per square foot of tank surface. Thus a tank 3½ feet diameter and 14 ft long, the upper half of which is filled with water whose temperature is 100 deg. higher than the room, will lose heat at a rate equivalent to 7 tons of coal per annum.

Most of these losses can be prevented by insulation. The cost of covering pipes and tanks will pay for itself within six months to two years.

Corrosion Prevention

A compresensive survey by the American Gas Association Testing Laboratory gives three methods for prolonging the life of hot water tanks. These are: (1) treatment of water, (2) proper precautions in tank construction, and (3) use of tanks of adequate capacity, with precautions against overheating.

The survey emphasizes that overheating increases corrosion. The report says, "The rate of water heater tank corrosion and the frequency of failures may be materially reduced if some scheme can be devised whereby the maximum available temperature in domestic boilers is limited to not more than 135 to 140 F. It is definitely known that the life of a boiler is much less when suppling high temperature water than when supplying water at a temperature of approximately 140 deg.

Regarding tank capacity, many tanks are so small that any unusual demand for hot water causes "no hot water" complaints. A common cause for abnormal hot water consumption is "running off" rusty water. Overheating the water to compensate for this waste increases its corrosiveness and thus starts a vicious cycle of trouble. Water treatment will eliminate the rusty condition and avoid the necessity for overheating.

DURING THE WAR electric power helped make it possible for American plants to turn out 2 billion small arms cartridges and 18 million artillery shells every month. Electric power drove the machines which produced 66,000 machine guns and 2500 large caliber field guns every 30 days.

LETTERS AND COMMENTS

The Story of the Steam Gage That Failed to Register

THE STORY under the above title by Sam J. Ayling in the January, 1946, issue, impressed me with the almost unbelievable practices that appear to exist in some boiler plants. This is not because someone had disturbed the gage pointer and caused it to come to rest on the wrong side of the pin. The really disturbing part of the situation is that any plant would attempt to operate without one or two spare gages or that there was no shut-off cock between the boiler and the gage.

If there was such a cock and the plant possessed a spare gage, what was to prevent the operator from removing the gage that failed to register and then checking the pressure with another gage?

Furthermore, if the water glass showed there was sufficient water in the boiler, even though two hours had elapsed, there should have been no cause for worry. All boilers have safety valves which pop at some safe excess pressure. If the safety valve had not popped, why take the boiler off the line?

Even if the plant was so poorly managed that there were no spare gage, the operators temporarily could have borrowed one from another boiler for a few moments, to check the pressure.

This comedy of errors recalls an incident I experienced years ago when inspecting some stokers at a plant in the South. The stokers were on a battery of new boilers but there was another battery of old hand-fired HRT boilers. One day I was strolling through the firing aisle of these boilers when I noted that the steam gage on one of these boilers showed 25 lb pressure. Since I knew that these boilers were cut into the line connecting to the stoker-fired boilers, I asked a negro fireman what was wrong with that particular gage.

He laughed and said: "Ah'll tell ya, boss! De pin done fell out ob dat gage and the needle's been around once." I said: "That's all I want to know. I'm leaving here plenty fast!"

Naperville, Ill. J. R. DARNELL

Parks Takes Issue with Fuite

IN THE JANUARY issue of POWER PLANT ENGINEERING, R. J. Fuite expressed his opinions of this magazine for publishing an article in the September issue by Mr. Henry Wallace.

It is very seldom that I take time to criticise or contradict something written by someone else, but this is one time that I cannot sit idly by and see a paper that has as much engineering publication to its credit, referred to in this manner.

I do not know when the first POWER PLANT ENGINEERING magazine was printed or do I know the history behind the organization other than from my own experience. I do know, however, that I have been a subscriber to POWER PLANT ENGINEERING for over 18 years. In all of this time, I cannot remember once when this paper was criticised for its selection of articles or material. I have always enjoyed with deepest interest reading POWER PLANT ENGINEERING during these years and have profited many times by the numerous articles and diagrams printed therein.

As far as Mr. Fuite is concerned, I think that he has made a very serious mistake and that he should reconsider for a minute. Why should Mr. Wallace's article or anyone else's for that matter, be excluded from this or any other American paper simply because he or anyone else doesn't like the man that wrote it? What kind of a paper would this be if it showed predilection in its choice of material?

As far as Mr. Henry Wallace is concerned, he is an American and as such, he enjoys the privilege of freedom of speech and has the right to think or speak as he feels or sees fit.

As far as the editors or POWER PLANT ENGINEERING are concerned, they have probably edited magazines and papers before Mr. Wallace was ever heard of and will continue to do so for a great many years to come. They have the right and I might say duty to print any article that anyone cares to submit. When I say duty, I mean a duty to its readers to keep this paper the unpredilected, universal paper that it always has been. This magazine travels all over the world and reaches million of hands and eyes. It has served the engineering field for many years. With all of this experience behind it, I can only consider Mr. Fuites remarks of POWER PLANT ENGINEERING as inimical and pernicious.

I ask all readers of POWER PLANT ENGINEERING to join me, in all sincerity, in requesting an immediate apology from Mr. Fuite to the editors.

CHAS W. PARKS.

Baltimore, Md.

Editor's Note: We appreciate Mr. Park's comments on Mr. Fuite's absurd and childish attitude. After all, the article in question was merely an effort on Mr. Wallace's part to indicate how the Department of Commerce could be helpful to the small businessmen of this country. It had nothing to do with political matters and was a sincere desire on the part of the Secretary of Commerce to extend and make useful the offices of his department. Mr. Fuite stated in his letter, "I presume that you contributed in cash for the tripe he (Henry Wallace) dishes out." Well Mr. Fuite presumed wrongly; we did not pay Mr. Wallace or anybody else anything for the article in the September issue. It was abstracted from a report issued by the Institute of Business Economics. We presented it on that page because, regardless of what Mr. Fuite or anybody else thinks, Mr. Wallace, as Secretary of Commerce, is a "leader" in our American scheme of things. The page on which the article appeared is a regular department of *Power Plant Engineering*, entitled "What Leaders Say." The material which we present on this page may or may not agree with the thoughts or political or economic opinions of the editors. Frequently we present articles with which we as editors do not agree but we feel that on this particular page at least every man can have his say. As Mr. Parks says in his letter Mr. Wallace is an American and, as such, he enjoys the privilege of freedom of speech. If Mr. Fuite wants to cancel his subscription to *Power Plant Engineering* merely because we published Mr. Wallace's article, that's his own hard luck. We intend to continue the policy we have been following with respect to the "What Leaders Say" page. It seems somewhat strange that Mr. Fuite should hail from the city of San Francisco. That city has the reputation of being one of the most civilized in the United States.

On the Meaning and Use of Enthalpy

The following has to deal with the article appearing in your January 1946 issue.

"The Meaning and Use of Enthalpy," by Mr. Tyler G. Hicks, has the advantage of trying to evaluate to the practical engineers the meaning of the so called A. P. V. product, that

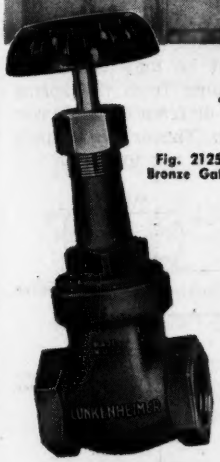

Fig. 2125 Bronze Gate

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He knows, in short, that his own product is thus given added salability, and in use will give the purchaser maximum results at minimum cost.

Whenever and wherever you purchase power equipment units, you'll be wise to look for the Lunkenheimer name on valves and lubricators—a *positive guide to value*.

THE LUNKENHEIMER COMPANY, Cincinnati 14, Ohio, U.S.A. (Offices: New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Department: 318-322 Hudson Street, New York 13, N. Y.)

Fig. 1430 Iron Body Gate

Gate Fig. 16 "Renewo" Globe

***Perhaps YOU Have A Product That Can Be Given This Added Sales Advantage.** If your products require the use of valves, lubricators, air devices, or boiler mountings, the name Lunkenheimer on such equipment will provide extra sales appeal. For further information see your nearest LUNKENHEIMER DISTRIBUTOR.*

Fig. 1834 "Alvar" Constant Level Oil Control

Fig. 1571 Air Cock 150 Lb. Pressure

LUNKENHEIMER VALVES

BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

appears in the mathematical expression of Enthalpy.

Enthalpy evidently consists of two items. Each one is a form of energy of *any* fluid in motion.

But a fluid in motion possesses other forms of energy and to say that the sum of internal energy, which the author designates by E, and the A. P. V. product is the "total energy" may lead to an erroneous conception.

A fluid in motion may have energy due to position, potential energy, due to velocity, kinetic energy. Therefore, we cannot say "the total energy of the stream" if we speak only of the internal energy and that due to work done in forcing a definite volume of fluid into, or out of, a vessel against the constant pressure, P.

In the scientific sense, work is defined as the product of force by distance and is expressed in ft-lb. The internal energy of the stream is expressed in Btu, hence the work done must also be expressed in Btu, if we wish to combine the two items in one concept—enthalpy, Joules constant, J comes to the rescue. A. is the reciprocal of J.

$$A = 1/778$$

The author proves that force,

$$F = P \times A \ldots 1$$

By definition Work $= F \times d \ldots 2$

Substituting the value of F from 2 we have $F = P \times A \times d$

But $A \times d =$ volume, V

Hence $Wk = P \times V$ in ft lb

$$\text{or } Wk = \frac{PV}{J} = APV \text{ in Btu}$$

and $h = i + APV$

$$H = h \times w$$

Where h is spec. enthalpy Btu per lb.
i — internal energy, Btu per lb.
V — specific Volume, cu ft per lb.
H — total enthalpy, Btu
W — weight of substance in lb.

The tables give h, specific enthalpy.

In as much as we are addressing the practical engineer, it seems advisable to explain the meaning of the Joules Constant, 778 (round figures). James Prescott Joule (1818-1889), an English Scientist, made significant researches in the budding science of thermodynamics. In this science he established the fundamental principle: the equivalence of heat and work. For every amount of work done a definite amount of heat appears. If one Btu is spent 778 ft-lbs work appears; and vice versa. Because of the work done by Joule to establish the relation between heat and work, the constant 778 is called Joules Constant.

Philadelphia, Pa. J. YAVITCH

IN SUMMER 870 miles of telephone cable stretches to 960 and shrinks to 780 in winter. Automatic regulators neutralize the effects of seasonal temperature changes—even daily variations.

A SINGLE fluorescent lamp requires 1000 distinct manufacturing operations and is assembled from 36 separate parts.

Questions And Answers

Question No. 327

Another Water System Problem—Re-design the Control

READING THE REPLIES to F. J. H.'s problem concerning a village water system prompts me to submit another somewhat similar problem. The system, serving a summer resort for about four months in a year, consists of a spring as a source of supply, a concrete reservoir for storage, two single-phase, 3-hp, motor-driven pumps for pumping water from the spring to the reservoir and from the reservoir to an open tank situated on a hill near the resort. This tank is equipped with a high and low level float switch. From the hill tank, water is piped to taps at each street corner throughout the resort village.

During the absence of the regular operator overseas, some rather unorthodox and confusing changes had been made so that much of the flexibility of the system was lost. The diagram shows the present hook-up, which the returned operator wants changed so that he may use either pump for pumping from the spring to the reservoir or from the reservoir to the hill tank. The original piping of the system was not touched.

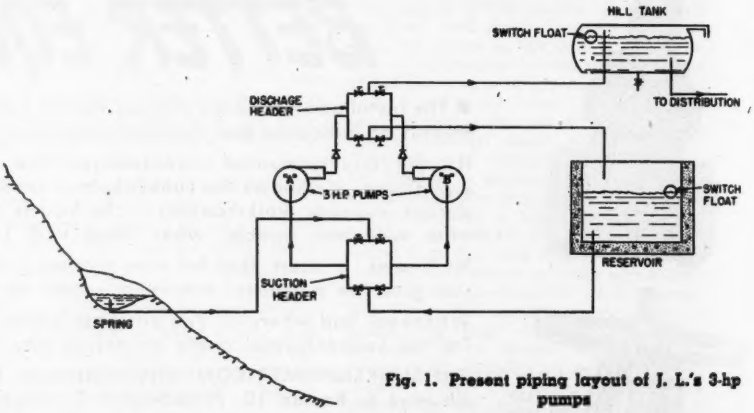

Fig. 1. Present piping layout of J. L.'s 3-hp pumps

It might be added that the pump serving the reservoir from the spring is to be hand controlled—generally left on during night hours, as the concrete tank is so large that the present 3-hp pumps cannot fill it to overflowing. The motor of the pump serving the hill tank from the reservoir is to

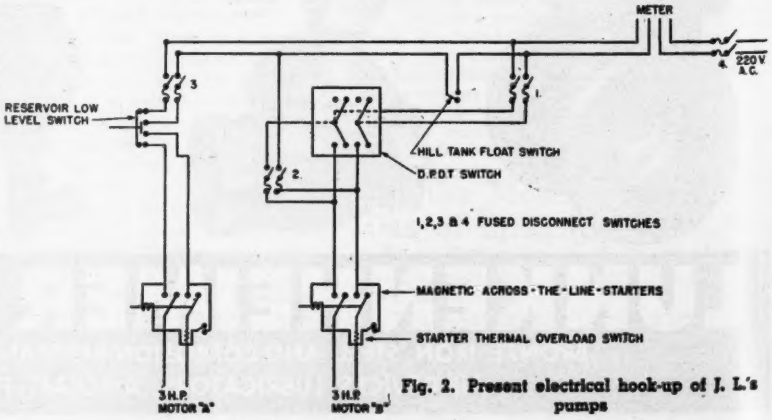

Fig. 2. Present electrical hook-up of J. L.'s pumps

From End to End of Power Piping Uniform Quality Stands Guard

Can you say that for your power plant? . . . process piping? . . . or heating system? If the answer is no, take special note of the three-way advantage you get in choosing piping materials from the world's greatest line—Crane.

ONE STANDARD OF QUALITY
ONE RESPONSIBILITY
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For any piping system—for any working conditions—a single order to your Crane Branch or Wholesaler covers everything required for the installation. Not only the valves and fittings in brass, iron, or steel, but all the pipe, piping accessories, and fabricated piping.

Undivided responsibility for all materials simplifies buying and guards against installation troubles. Crane quality—backed by 90 years of manufacturing "know-how"—keeps piping systems on the job longer, at lower cost.

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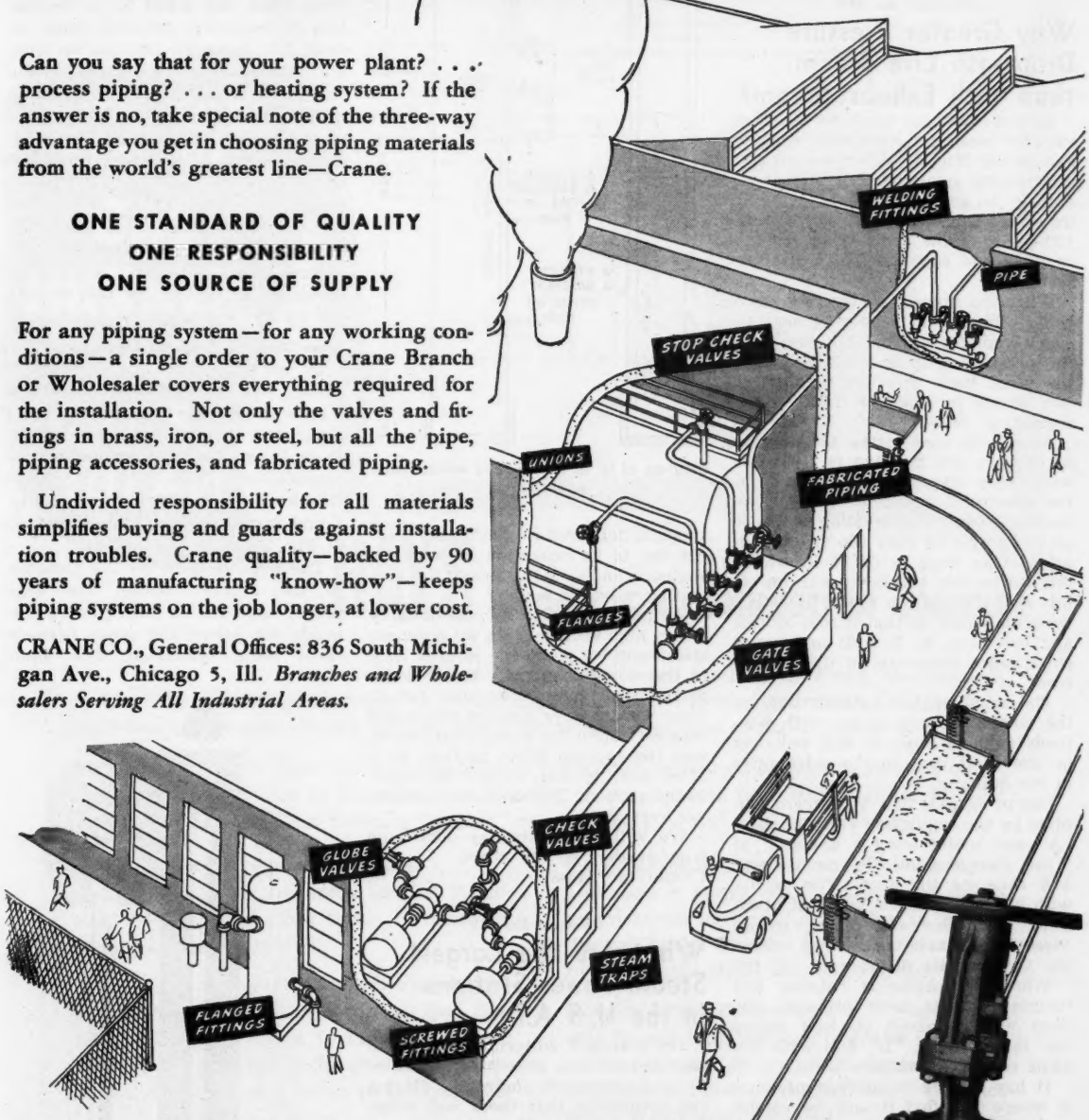

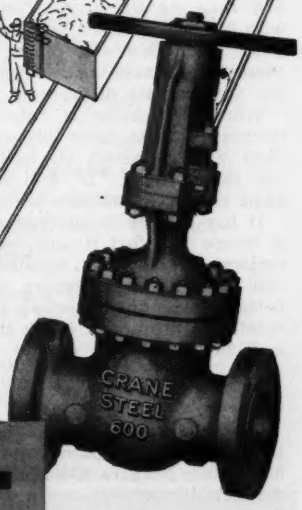

(*Right*) Typical of the uniformly high quality in Crane products—Crane Alloy Steel Wedge Gate Valves. The 600-pound class, with Exelloy to No. 49 Nickel Alloy seating, is recommended for steam, water, gas or air up to 850° F. maximum; with Stellite to Stellite, for steam up to 1000° F.; with Exelloy to Exelloy, for oil or oil vapor up to 1100° F. Screwed, flanged, or welding ends. See your Crane Catalog for complete specifications.

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FOR EVERY PIPING SYSTEM

be wired to both the float switches in the two tanks. With the present hook-up the hill tank float switch requires frequent contact replacement.

North Battleford, Saskatchewan, Canada — J. L.

Question No. 328

Why Greater Pressure Drop with Live Steam than with Exhaust Steam?

IN OUR PLANT we have the familiar vacuum heating system with engines exhausting into it. When no engines are running, steam purchased from an outside steam company is reduced through a 2-in. regulating valve from 120 psi to a low pressure of from 1 to 3 psi and supplied to the heating system.

When the engines are running there is no difficulty in supplying heat to every radiator in the building and the pressure drop is much less with the same back pressure than when live steam is supplied through the regulating valve.

As will be seen in the accompanying sketch, the building is U-shaped with fairly long runs of piping from the source of supply to the various heating risers. The building is 200 ft on front and its runs 400 ft on each wing. One wing is 55 ft in width, five stories and basement with an office structure on the roof. The other wing and front section is four stories and basement, 65 ft wide and has a small office structure on the roof at front.

The main engine exhaust pipe in the power house is 10-in., with 8-in. feeds running from it and reducing in size as it runs to the extremities of the building.

Our problem is that with steam supplied by the regulating valve at point "A" and maintaining a pressure of 3 psi, then at point "B" no pressure will show on the gage. This occurs with a vacuum at the pump of about 5 in. With that size piping, should there be as much of a drop within the approximate distance of 120 ft?

When the engine is running and maintaining the same pressure, the drop will be about one-half pound (½ lb) at point "B" and with the same or higher vacuum.

It has seemed to us that pressure is where you find it and we cannot understand why the exhaust steam can maintain the pressure so much better, unless the pulsating action is helpful in pushing it along the pipes and that the heat of the exhaust steam is delivered in a different manner due to its expansion through the engine cylinder. Also, should the regulating valve be larger?

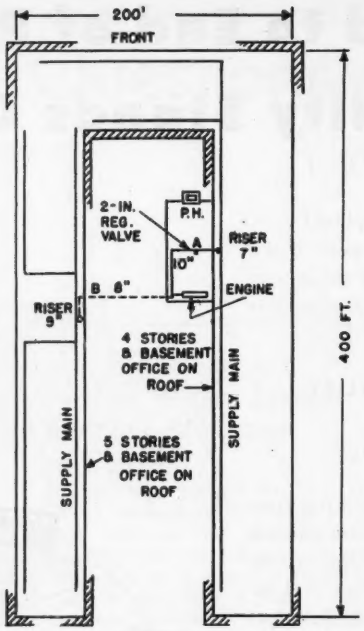


Diagram of G. H. K.'s heating system main feeder piping

We might add that we cannot carry a very high vacuum since we purchase steam and we pump the returns back to the steam company's boiler house and are given an allowance for it. They wish to have distilled water and thus we cannot run a cold water spray into the vacuum pump suction, as is often done to help reduce the vapor in the suction. Therefore our returns are very hot.

We will appreciate any comments from readers on the above.

Cambridge, Mass. — G. H. K.

Question No. 329

What Are the Largest Steam Power Stations in the U. S. A.?

ON A RECENT editorial trip, one of our editors was asked this question by many different engineers. He got the impression that there was widespread interest in the subject.

The largest individual steam power stations in the country, in order of size down to 400,000 kw, are as shown in this table:

1.	Consolidated Edison Co. of N. Y., Hudson Ave. Station (Brooklyn)	770,000 kw
2.	Consolidated Edison Co. of N. Y., Hell Gate Station	565,000 kw*
3.	Buffalo Niagara Electric, Huntley Station	545,000 kw
4.	Consolidated Edison Co. of N. Y., Waterside Station	498,200 kw
5.	Commonwealth Edison Co., Crawford Station	437,500 kw
6.	Ohio Power Co., Philo Station	415,000 kw

*Does not include the 65,000-kw topping unit now being installed (see Power Plant Engineering, November, 1945, February, 1946) which will raise the total capacity to 630,000 kw.

Answer No. 309

How Does Level Indicator Work on Brine Cooler?

WHEN W. M. H. said the level indicators on his brine coolers didn't work right and asked for a description of indicators correctly built, he drew first some fine information from our old friend George Holman, in the November issue. Then we turned up a former design employing a gage glass type of indicator by Frank M. Bennett, and in passing, remarked on the progress made in gage glasses, design and construction, and in remote reading level gages since Mr. Bennett's article was written.

Now comes data on a gage glass developed especially for this work—but let Mr. Ruppright have the floor.

Gage Glass for Ammonia Liquid Level

IN REFERENCE to this problem, I should like to call attention to a direct-indicating refrigerant level gage that is now on the market. It is known as the Lo-side and is manufactured and sold by Meade Goodloe. It is built as shown in Fig. 1 and installed on a brine cooler as in Fig. 2.

The gage is built on the principle of the vacuum bottle. The gage proper consists of two glasses, one inside the other, the space between them being evacuated. The liquid

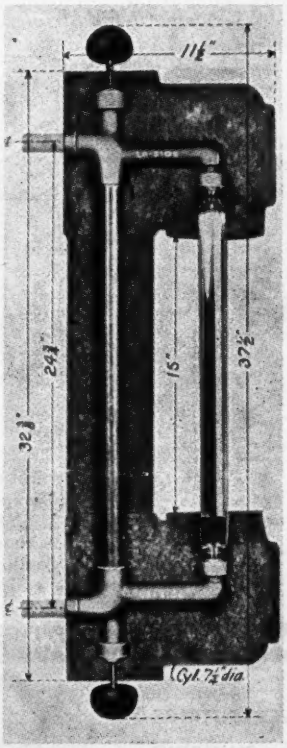


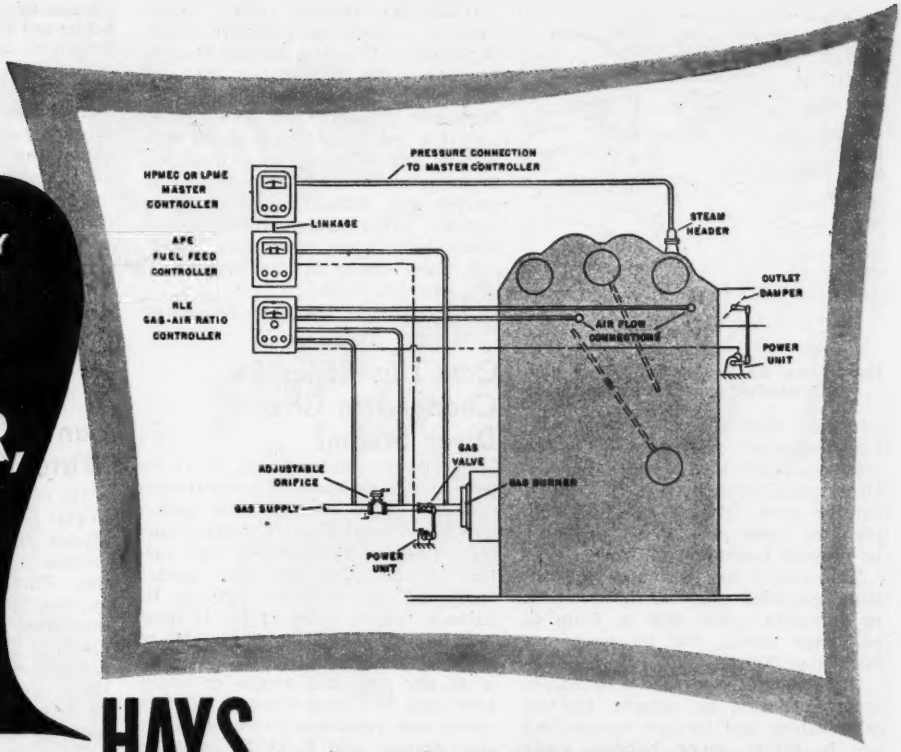
Fig. 1. Cross-section through Lo-Side ammonia liquid level gage, referred to by S. Ruppright

WITH ANY TYPE OF

GAS BURNER,

too,

IT'S IDEAL!



HAYS *automatic* COMBUSTION CONTROL

It's the modern "better way"—electrical in its speed, electrical in its utter dependability, electrical in its automatic simplicity: Hays Combustion Control. It is truly an ideal system, in any type or size of plant, with any type of fuel . . . gas, oil or coal.

Automatically it keeps air and fuel rates in accurately measured proportion to each other, and in proper relation to the plant load. Result . . . you operate your boilers closer to their maximum capacity. You actually "stretch" its capacity . . . and with entire safety.

- ***Master Steam Pressure Controller*** . . . . connected to the main steam header, it controls operation of other units, to maintain steam pressure constant.
- ***Fuel Feed Controller*** . . . is adjusted by the Master Controller for the rate of gas flow required for the steam to be generated. It controls the pressure of the gas at the burners by operation of a valve in the gas line.
- ***Gas-Air Ratio Controller*** . . . measures the flow of gas and proportions the air flow to the gas flow by operating the inlet damper. Gas flow is measured by taking the differential across an adjustable orifice in the gas line while the air flow is measured usually by taking the draft loss through the boiler.
- ***Furnace Draft Controller*** . . . (used only with forced draft burners) operates the boiler outlet damper, to maintain furnace draft constant at the predetermined value for which it has been adjusted.

If desired, the Hays Combustion Control can be easily switched from automatic to full or partial manual operation.

You'll find Bulletin 46-605 exceedingly helpful—contains full information, with schematic drawings of 14 different applications. Write for it.

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Automatic COMBUSTION CONTROL

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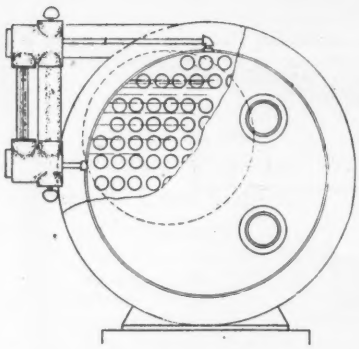


Fig. 2. How the Lo-Side liquid level gage is installed on a brine cooler

ammonia rises into the inner glass and the outer glass is silvered to repel radiated heat except along a clear space through which the liquid can be seen. The vacuum between the two tubes acts as an insulator to prevent formation of frost.

The glasses are designed to withstand expected evaporating pressures in ammonia units; that is, from 45 psi gage down, but no gage has broken at 100 psi.

The fittings are covered with molded cork insulation as shown. Bubble-trap valves and by-pass connections act to divert vapor bubbles away from the gage tube. The assembly has been standardized in one size to show 15 in. of glass. More than one assembly has not been found necessary on an evaporator except for experimental purposes.

I have seen this gage in operation and have found the users well pleased with it.

I might add a few lines on why such an elaborate device is needed, because the manufacturer mentions only frost on an ordinary glass as justification for its existence.

If this were the only factor, a glass such as is used on receivers would be usable with a rag soaked in alcohol handy for wiping the frost off when a level inspection is wanted. However, exposure to air warmer than the refrigerant causes gas bubbles to form and to raise the level in the glass to such an extent as to render any indication in the glass useless. Often enough, these bubbles maintain a lively circulation, up in the glass—down in the evaporator.
Los Angeles, Calif.

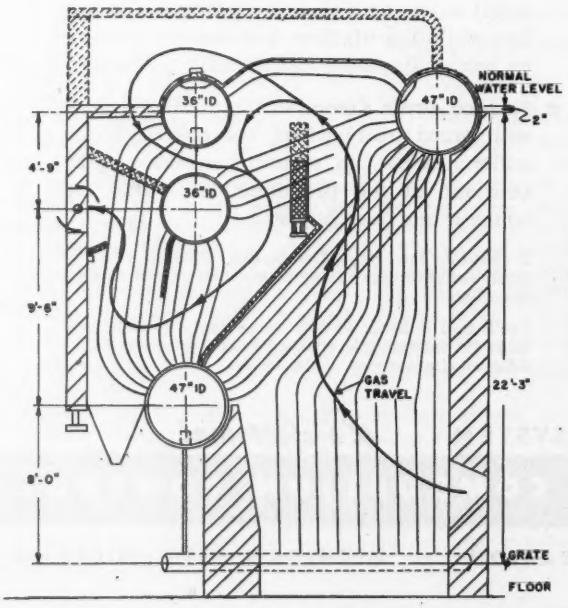
SIEGFRIED RUPPRIGHT

Answer No. 313

Can This Boiler Be Changed to Give Dryer Steam?

IN THE November issue, E. O. D. showed a diagrammatic cross-section of his 4-drum water-tube boiler, which has 4600 sq ft of heating surface, water-cooled furnace wall surface of 320 sq ft, side wall header surface 15 sq ft, total 4935 sq ft; furnace volume 1350 cu ft. It must generate as much as 30,000 lb of steam an hour at 130 psig, make-up is 45 per cent and details of water level and feedwater were given. The boiler now generates steam of 85 per cent dryness and E. O. D. wants to know if it can be changed to deliver steam of 98 per cent dryness.

In the January and February issues, C. W. Parks and E. R. Webber presented designs for steam drum internals to eliminate moisture from the steam generated by this unit—in other words, steam dryers and washers. Below is another idea for changing the boiler to accomplish the purpose, by changing the baffling and setting to direct the flue gas over the top rear drum, giving a superheating effect.



Sketch by Leo Schulte showing how setting and baffles of E. O. D.'s boiler can be changed to enable boiler to give dryer steam

Changes Gas Flow by Changing Baffles and Setting

REMOVE 2nd pass between top rear drum and middle. Build a baffle from center drum to the back wall and extend this wall beyond top drum, as shown in the sketch. Other baffles can remain. I think the baffle change should be figured out according to the type of fuel used, oil, gas or coal.

In starting up a cold boiler with this change, it will be safer to fill it full of water until it steams, when it can be drained to right level. Experiment to find best water height to obtain dryest steam.
Detroit, Mich. LEO SCHULTE

Answer No. 314

Can He Use Green Bean Water for Boiler Feed?

NO DEFINITE ANSWER can be given to this question until the water is analyzed by a competent feedwater chemist to determine its characteristics. This was our original opinion, as sent to this questioner, and it is confirmed by all the replies from engineers. They all feel that such an analysis would show it is not possible to use it. And even if it proved to be possible, the cost of treatment might be prohibitive.

If so, the only thing R. M. S. should consider is the recovery of the heat in the water by a heat exchanger, as explained by N. T. Pef in the March issue. Here are the ideas of two other engineers, re-inforcing these points.

Analyze Water and Costs Carefully

MY ANSWER to this question is that the water would have to be analyzed right away to make sure what it contains. This test will have to be done by a person or some reliable water treatment concern who would be able to ascertain just what could be done in the way of treatment so as to use the water. After the water is analyzed and if treatment can be used to keep the water in a state fit for feedwater, R. M. S. will have to figure the cost of cleaning the water and treating it. Will this pay in dollars and cents at the end of the year? If not, it is better, safer and cheaper in the long run to let this bean water go to waste.

This question by R. M. S. shows he is an engineer interested in his position and thinking of his costs in the power plant as well as the front office. I sure wish there were many more of his type around today.
Philadelphia, Pa. T. F. CUNNINGHAM

Let Well Enough Alone

IN ANSWER to R. M. S'. question on purification of green bean contaminated water, I want to advise him that although he could purify the water for boiler use, the method of purification would be expensive and in his case would not result in any direct economy.

If he should use the water as it is, he would have considerable priming in his boilers as he anticipates. This,

3,000 psi 1,000°F

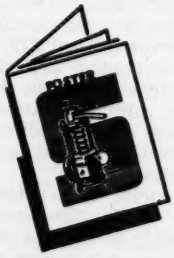
THIS NEW SAFETY VALVE

SAVES MONEY ON EVERY POP !

The Foster Type 38-SV Super-Jet Safety Valve for pressures up to 3000 pounds and temperatures up to 1000° F.

Because it reseats as close as 1% below popping pressure, the Foster 38-SV Super-Jet Safety Valve saves steam—saves *money*—on every pop. This new valve blows off only enough steam for safety . . . then reseats positively, without pounding or chatter.

But steam economy is only one advantage of this new safety valve. It is virtually unaffected by changes in temperature—once set under operating conditions, its popping point is constant. It gives full rated nozzle capacity at popping pressure—with negligible accumulation. Full opening is practically instantaneous—reseating is positive, without flutter or rebound even after sustained or successive lifts. And blowdown is adjustable from 8% down to 1% without chatter or pounding because steam cannot accumulate above valve disc.



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PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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of course, is very unpleasant in any power plant.

I would advise him to find other uses for his hot water, depending, of course, on its Btu content.

Not knowing the type of plant he is in charge of, I can't go into lengthy detail on its use in his plant. As long as he has a feedwater condition where his boilers do not show scale accumulations, I would advise him to let well enough alone.

Ridgefield, N. J. JOHN F. SLAVINSKY

Answer No. 316

How Detect Contamination of Heater Condensate by Oil?

HE HAS A HEATER in which oil flows through the tubes, its pressure being higher than that of the steam outside the tubes, said E. H. R. in the December issue. Hence, if any of the tubes develop leaks, the oil will contaminate the condensate. This condensate, however, must in turn flow on to another process from which oil must be excluded. So, to detect any tube leakage in the heater, E. H. R. wants to know what devices he could use to inform him at all times of the internal conditions in the heater and possibly to actuate controls to shut off steam and water.

In the March issue, W. Schaphorst suggested using a cloth type filter for the condensate and measuring the pressure drop across it, which would increase if the filter began to trap out oil. Jesse L. Erisman showed details of an oil separator for the condensate discharge, equipped with electrically-actuated indicating and control devices. Here are some more ideas.

Measure Oil Pressure Drop or Inspect Condensate Samples

IN ANSWER to E. H. R.'s question about installing a telltale device for discovering a leak in his heater tubes, he could use a two gage idea. He could install a pressure gage on the inlet side of the oil connection entering the heater and another pressure gage on the outlet side of the oil piping leaving the heater. If there should be a noticeable pressure drop between the two gages readings, he then, of course, will know that the tubes are leaking.

Another method he could use would be to draw off a sample of the condensed water every day and let it stand in a container until the sample cooled off. If the water is contaminated with oil he would then be able to detect it floating on top of the water.

These things he could do himself. Of course, there are warning devices which could be purchased on the market that would be designed to work on the pressure drop in the oil at the heater. But whether it would pay him to install one depends on just how important the process is.

Ridgefield, N. J. JOHN F. SLAVINSKY

Answer No. 318

How Burn Butane Under This Boiler?

WHAT KIND of burners, furnace construction, tanks and so on should he use for burning butane under his 150-hp Economy boiler? asked C. L. H. in the January issue. He also wanted to know about the probable cost as compared with burning coal.

In our original reply to C. L. H., we gave him a list of manufacturers of gas burners and accessories in his vicinity. But our own files failed to disclose much specific information on burning butane. We were sure, however, that the author of the Boiler Fireman's Handbook would not fail us. Sure enough, he came through with these helpful comments.

Butane Like Refinery Gas

IN CHAPTER XIX of the Boiler Fireman's Handbook in the March issue, I discuss various kinds of gas firing but do not specifically mention butane, since it is often found in refinery gas and may be treated as such; although if this one gas alone is burned, the fireman may have difficulty in getting complete combustion without sound advice on the type of burners to use.

Butane is a relatively heavy hydrocarbon having the chemical formula C^4H^{10}. It has a weight of 0.153 lb per cu ft, compared with an average weight of about 0.07 lb per cu ft for most refinery gas. Although its heat value per pound is just about the same as average refinery gas—21,300 Btu—its heat value per cubic foot is very much higher. Butane has 3274 Btu per cu ft whereas average refinery gas has about 1400 Btu per cu ft.

I would advise C. L. H. to get in touch with several manufacturers of gas burners, particularly those having burners which premix the gas and air before firing. For best results this premixing should be effected with forced draft and air preheating.

As to the relative costs of firing butane and coal, data on so many variables are required before an economic study can be made that one would have to visit the plant and ask many questions before any bonafide comparison could be made.

Naperville, Ill. J. R. DARNELL

Answer No. 319

What Should His Fuel Oil Temperature Be?

HOW CAN HE determine the correct temperature of his No. 5 fuel oil as it comes from the oil heaters, asked J. C. P., when all he knows about the oil is its flash point?

Well, here's our good friend, Wm. T. Mullen to the rescue.

Hold Fire Point Above Flash Point

THE OIL COMPANY always sends—or should send—the temperature that the oil is to be burned at. If this isn't the case with J. C. P., he can find the fire point by carrying the temperature of the oil 10 deg above the flash point. If the temperature in the tank is 90 deg, then the oil is pumped from the tank and through strainers to fuel pump to heater, where this temperature is raised to the fire point. The oil then flows through the oil line to the burner and is atomized and burned.

The 10 deg that J. C. P. is puzzled about is the difference between flash and fire points. As for the carboning of oil in the fuel oil heater is that the temperature of the oil is carried to a point above the fire point and the carbon content is then separated from the fuel oil.

The best way for J. C. P. is to know his flash point or his fire point for every load of oil and to maintain this fire point in the oil heater to the burner as steady as possible; because if the temperature of the oil gets below the flash point, then combustion will not always be complete. It is better to go a few degrees above the fire point than below the flash point.

Philadelphia, Pa. WM. T. MULLEN

Answer No. 322

What Is Specific Heat of Soapstone?

ALTHOUGH there is plenty of information in the literature about refractories, we could find very little with which to answer W. T. B.'s request for the specific heat of soapstone, used as refractory material in certain pulp mill equipment. So we are very glad to get this comment from Mr. Darnell.

Data on Specific Heat and K Factor of Soapstone

I DOUBT if W. T. B. intends to use soapstone as a refractory in the sense that we think of refractories used in boiler furnaces.

Soapstone and its variants, talc and steatite are acid magnesium silicates. Since talc has a mean specific heat of 0.209 between 32 and 212 F, it is reasonable to assume that the particular soapstone has about the same specific heat. Specific heats of various substances have no direct relationship, however, to heat conductivity or "K" factor.

The "K" factor of a substance is the number of Btu flowing in 1 hr through 1 sq ft of surface area and 1 ft of thickness per degree of mean temperature difference. The "K" factor for graphite is 2.9 but the specific heat is 0.201. On the other hand, the "K" factor for granite is 1.3 while its specific heat is 0.195. The "K" factor for porcelain is 0.60 while its specific heat is 0.255.

Although I do not have any definite figure for the "K" factor of soapstone or talc, my guess is that it will average about 0.5 in the range of 32-212 F. As the temperature increases, its "K" factor value will also increase, but probably not as straight line function.

Naperville, Ill. J. R. DARNELL

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Answer No. 323

Steam Engine Questions

IN THE February issue, J. L. P. asked:

1. How would you determine the diameter and weight of the flywheel on a steam engine? and

2. Why is the first half of the stroke of the piston from the head end of an engine accompanied by less than ¼ of a revolution of the flywheel and the second half stroke by more than ¼ revolution?

The brethren rallied round on these two. Here are typical helpful replies.

Calculations from Septor

1. THE DIAMETER and weight of flywheel. The diameter of a flywheel, for any given speed in rpm, is limited to the maximum safe rim velocity, which is about 6000 ft per min for a solid cast-iron wheel.*

For determining the weight of a flywheel, when the speed and diameter have been fixed, here is a formula from Modern Steam Engineering by Gardner Hiscox, published in 1919, a rather old book.

$$\text{Weight of flywheel} = 250{,}000 \frac{A\ S\ P}{R^2\ D^2}$$

A = area of piston in square inches, S = stroke in feet, P = mean effective pressure psi, R = revolutions per minute, D = outside diameter of flywheel in feet.

2. The reason why the first half of the piston stroke from the head end is not accompanied by a quarter turn of the crank, is due to the angularity of the connecting rod; that is, the angle of the connecting rod, at any point of the stroke, relative to the piston rod. This I think can be explained better by the two accompanying sketches.

If an engine with a two 2-ft stroke and a 4-ft rod should be stopped with the crank pin at point B, Fig. 1, and the crank end of the rod disconnected, without moving the piston, and dropped to point F, 180 deg from B, it would scribe an arc B D F. Length C D represents the distance the piston is leading the crank at a quarter revolution from head dead center.

The angle of the rod A and the distance C D, the versin of angle A, can easily be determined, as follows: The lines A B, A C, B C, form a right-angled triangle: C = 90 deg, c = 48 in., a = 12 in.

*A solid cast-iron wheel is cast in one piece. When wheels are in sections bolted together, the efficiency of the joints must be considered.

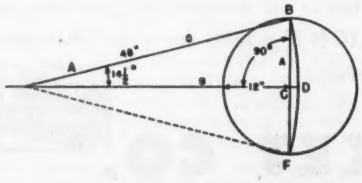


Fig. 1. Diagrams by R. Septor showing effect of connecting rod angularity

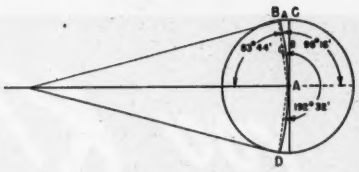


Fig. 2. Diagram by R. Septor showing calculation of crank position at ½ stroke

$$\text{Then } \sin A = \frac{a}{c} = \frac{12}{48} = 0.2500.$$

The corresponding angle is 14½ deg. $b = c \times \cos A = 48 \times 0.9682 = 46.47$ in. C D = c − b = 48.00 − 46.47 = 1.53 in.

Now moving the piston back 1.53 in. to mid stroke of the piston, the arc becomes B A D, Fig. 2, and we have a right triangle in the crank circle, with two sides known, a and b; a = 1.53 and b = 12

$$\tan A = \frac{a}{b} = \frac{1.53}{12} = 0.1275$$

Angle A = 6 deg 16 min.

Then at one half stroke of the piston, the crank has turned 90 deg − 6 deg 16 min. = 83 deg 44 min., the same is true for that portion of the return stroke while the two half strokes in the rod end of the cylinder turn the crank through 96 deg 16 min each or a total of 192 deg 32 min of angle.

South Amboy, N. J.

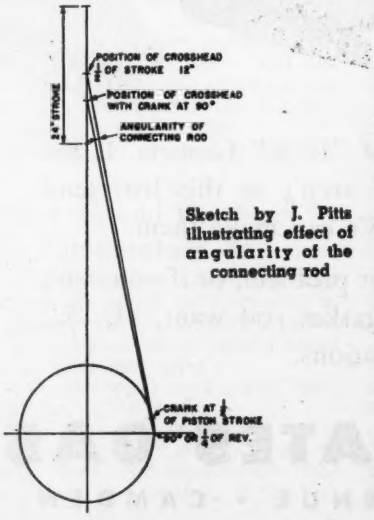
RAYMOND SEPTOR

Explanation by Pitts

THE REASON for various distances of travel by the flywheel and the piston is the angularity of the connecting rod, which is the angle between the axis of the piston rod and the axis of the connecting rod.

The circle travel of flywheel or crank from top dead center to the position of 90 deg, or ¼ revolution, is greater in distance than the travel of crosshead in a straight line to ½ of stroke, thereby giving a different angle to the connecting rod. On the first half of the stroke toward the crank, the average velocity of the cross head will be greater than on the second half of the stroke. Enclosed is a simple drawing illustrating the angularity. .

Ontario, Calif. JACK PITTS


POSITION OF CROSSHEAD ½ OF STROKE 18"
POSITION OF CROSSHEAD WITH CRANK AT 90°
ANGULARITY OF CONNECTING ROD
24" STROKE
CRANK AT ½ OF PISTON STROKE
90° OR ¼ OF REV.

Sketch by J. Pitts illustrating effect of angularity of the connecting rod

References by Duffey

1. REFER to Section 11—Rotating Members, pages 11-15 to 11-24, Fly Wheels; Kent's Mechanical Engineers' Handbook, Eleventh Edition, Volume 3, Design—Shop Practice.

2. Refer to Section 11—Rotating Members, pages 11-10 to 11-14, Cranks and Crank Pins, Kent's Mechanical Engineers' Handbook, Eleventh Edition, Volume 3, Design—Shop Practice.

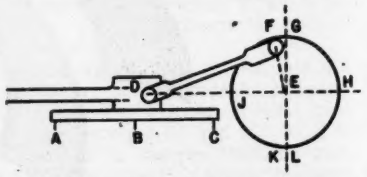
I believe that J. L. P. will find the data in Kent's will very satisfactory answer his question.

Youngstown, Ohio PAUL R. DUFFEY

Explanation by Goldsmith

I THINK J. L. P. will understand the relationship between revolution of the flywheel and stroke of the crosshead or piston if he will study the accompanying diagram, keeping in mind the fact that the crank and flywheel have the same motion since they are both fixed to the same shaft.

Now if the crankpin moved in a straight line, as the crosshead does, there would be no unequal motion. When the crosshead completed one-half stroke, the crank pin would move from J to E and would move one-half stroke also. However, the crank pin travels in a circle, with this result: When the crosshead moves one-half stroke, from A to B, the crank pin moves only from J to F. To complete one-half stroke, the crank pin must move from J to G. Obviously the distance from D to G



Sketch by Goldsmith explaining effect of connecting rod angularity

is greater than from D to E, which is the position the crank pin would occupy if it moved in a straight line. Therefore, the crosshead has completed one-half stroke while the crank pin is short of its half stroke position.

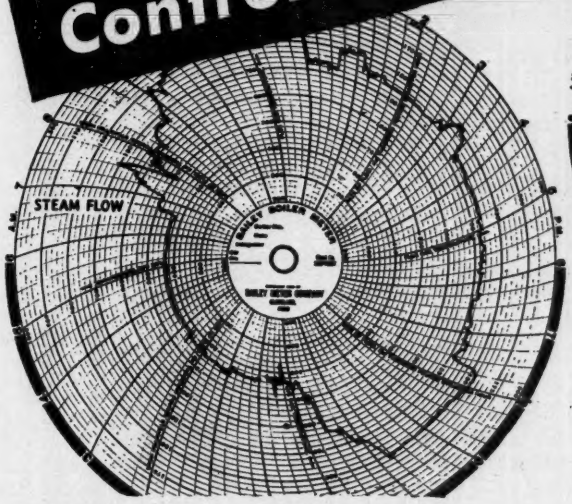
Consequently, this result must be obtained: The crank pin and crosshead have to reach the end of their strokes together, so the crosshead is going to move another half stroke while the crank pin moves more than half stroke, from F to H.

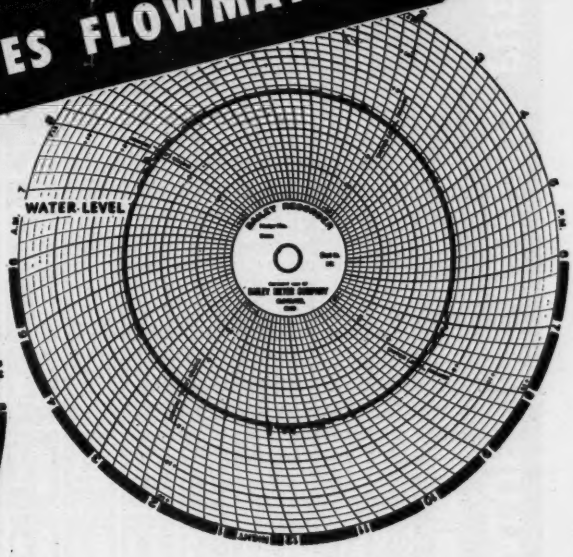
From this is is obvious that on the first half-stroke the crank (and flywheel) has not completed half stroke, while on the last half-stroke, the crank turns through more than half-stroke.

Beverly, Mass.

RALPH B. GOLDSMITH, JR.

The Boiler: ERIE CITY 3-DRUM, 675 PSI
Drum Level: PLUS-OR-MINUS 3/4-INCH
Control by: COPES FLOWMATIC





If you want proof of performance, check these charts. They came from one of the two 675-psi boilers, each rated at 185,000 pounds per hour, in an Eastern utility plant. There is no pressure control on the three constant-speed motor-driven centrifugal boiler feeders, each of which has a capacity of 445 gpm at 875 psi. This means there are wide changes in the differential water pressure as the boiler load varies, but the COPES Flowmatic automatically compensates for such pressure changes.

Except for momentary "shrink" and "swell" during large load changes, the drum level is held within plus-or-minus ½-inch. Greatest level change recorded was 1½ inches between 7:30 and 8 a.m., when the load swung rapidly from 125,000 to 75,000 and back to 100,000 pounds per hour. Adjustment of the COPES Flowmatic is for a practically-constant level, although it could easily be changed to give either a rising or a lowering characteristic, if this were the operating preference.

The story of this installation is told in Bulletin 445. A request on your letterhead will bring you a copy. And when you write, outline your operating conditions. Find out how COPES Flowmatic might improve them.

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COMPARATIVE THERMAL VALUES OF VARIOUS FUELS

BASED ON THEIR RESPECTIVE UNITS OF WEIGHT OR VOLUME

Natural Gas 1000 B.t.u./Cu.Ft.	**1000** Cu.Ft.	550 Cu.Ft.	100 Cu.Ft.	150 Cu.Ft.	20,000 Cu.Ft.	24,000 Cu.Ft.	25,000 Cu.Ft.	26,000 Cu.Ft.	27,000 Cu.Ft.	28,000 Cu.Ft.	140 Cu.Ft.	145 Cu.Ft.	150 Cu.Ft.	155 Cu.Ft.	3.412 Cu.Ft.
Coke Oven or City Gas—550 B.t.u./Cu.Ft.	1818 Cu.Ft.	**1000** Cu.Ft.	181.8 Cu.Ft.	273 Cu.Ft.	36,400 Cu.Ft.	43,700 Cu.Ft.	45,500 Cu.Ft.	47,300 Cu.Ft.	49,100 Cu.Ft.	50,800 Cu.Ft.	255 Cu.Ft.	264 Cu.Ft.	273 Cu.Ft.	282 Cu.Ft.	6.2 Cu.Ft.
Blast Furnace Gas 100 B.t.u./Cu. Ft.	10,000 Cu.Ft.	5500 Cu.Ft.	**1000** Cu.Ft.	1500 Cu.Ft.	200,000 Cu.Ft.	240,000 Cu.Ft.	250,000 Cu.Ft.	260,000 Cu.Ft.	270,000 Cu.Ft.	280,000 Cu.Ft.	1400 Cu.Ft.	1450 Cu.Ft.	1500 Cu.Ft.	1550 Cu.Ft.	34 Cu.Ft.
Producer Gas 150 B.t.u./Cu.Ft.	6667 Cu.Ft.	3670 Cu.Ft.	667 Cu.Ft.	**1000** Cu.Ft.	133,500 Cu.Ft.	160,000 Cu.Ft.	166,500 Cu.Ft.	173,200 Cu.Ft.	179,800 Cu.Ft.	186,500 Cu.Ft.	934 Cu.Ft.	966 Cu.Ft.	1000 Cu.Ft.	1032 Cu.Ft.	22.7 Cu.Ft.
Coke Breeze 10,000 B.t.u./Lb.	100 Lbs.	55 Lbs.	10 Lbs.	15 Lbs.	**2000** Lbs.	2400 Lbs.	2500 Lbs.	2600 Lbs.	2700 Lbs.	2800 Lbs.	14 Lbs.	14.5 Lbs.	15 Lbs.	15.5 Lbs.	.3412 Lbs.
Coke 12,000 B.t.u./Lb.	83.4 Lbs.	45.8 Lbs.	8.34 Lbs.	12.5 Lbs.	1667 Lbs.	**2000** Lbs.	2080 Lbs.	2162 Lbs.	2250 Lbs.	2335 Lbs.	11.7 Lbs.	12.09 Lbs.	12.5 Lbs.	12.9 Lbs.	.284 Lbs.
Coal 12,500 B.t.u./Lb.	80 Lbs.	44 Lbs.	8 Lbs.	12 Lbs.	1600 Lbs.	1920 Lbs.	**2000** Lbs.	2080 Lbs.	2160 Lbs.	2240 Lbs.	11.2 Lbs.	11.6 Lbs.	12 Lbs.	12.4 Lbs.	.273 Lbs.
Coal 13,000 B.t.u./Lb.	77 Lbs.	42.3 Lbs.	7.7 Lbs.	11.55 Lbs.	1540 Lbs.	1845 Lbs.	1925 Lbs.	**2000** Lbs.	2075 Lbs.	2156 Lbs.	10.78 Lbs.	11.15 Lbs.	11.5 Lbs.	11.9 Lbs.	.262 Lbs.
Coal 13,500 B.t.u./Lb.	74 Lbs.	40.7 Lbs.	7.4 Lbs.	11.10 Lbs.	1480 Lbs.	1780 Lbs.	1850 Lbs.	1925 Lbs.	**2000** Lbs.	2075 Lbs.	10.38 Lbs.	10.72 Lbs.	11.1 Lbs.	11.48 Lbs.	.252 Lbs.
Coal 14,000 B.t.u./Lb.	71.5 Lbs.	39.3 Lbs.	7.15 Lbs.	10.70 Lbs.	1430 Lbs.	1712 Lbs.	1785 Lbs.	1857 Lbs.	1930 Lbs.	**2000** Lbs.	10 Lbs.	10.35 Lbs.	10.7 Lbs.	10.08 Lbs.	.244 Lbs.
Fuel Oil 140,000 B.t.u./Gal.	7.15 Gals.	3.93 Gals.	.715 Gals.	1.07 Gals.	143 Gals.	171 Gals.	178 Gals.	185 Gals.	193 Gals.	200 Gals.	**1** Gals.	1.03 Gals.	1.07 Gals.	1.108 Gals.	.0244 Gals.
Fuel Oil 145,000 B.t.u./Gal.	6.9 Gals.	3.8 Gals.	.69 Gals.	1.03 Gals.	138 Gals.	166 Gals.	172 Gals.	179 Gals.	186 Gals.	193 Gals.	.966 Gals.	**1** Gals.	1.032 Gals.	1.07 Gals.	.0235 Gals.
Fuel Oil 150,000 B.t.u./Gal.	6.67 Gals.	3.67 Gals.	.667 Gals.	1.00 Gals.	133 Gals.	160 Gals.	167 Gals.	173 Gals.	180 Gals.	187 Gals.	.934 Gals.	.966 Gals.	**1** Gals.	1.032 Gals.	.0227 Gals.
Tar 155,000 B.t.u./Gal.	6.45 Gals.	3.55 Gals.	.645 Gals.	.968 Gals.	129 Gals.	155 Gals.	161 Gals.	168 Gals.	174 Gals.	181 Gals.	.904 Gals.	.936 Gals.	.968 Gals.	**1** Gals.	.0220 Gals.
Electricity 3412 B.t.u./Kw.	293 Kw.	161 Kw.	29.3 Kw.	44 Kw.	5870 Kw.	7040 Kw.	7330 Kw.	7620 Kw.	7910 Kw.	8200 Kw.	41 Kw.	42.5 Kw.	44 Kw.	45.4 Kw.	**1** **Kw.**

Example in Use of Chart:—What quantity of Natural Gas corresponds to 1 gal. of 145,000 B.t.u. Fuel Oil?

Solution:—On the, "Fuel Oil, 145,000 B.t.u. Gal.", line proceed horizontally to the right until the unit of Fuel Oil, namely 1 is reached. Then proceed vertically to the Natural Gas line and read 145 cu. ft. which is the equivalent of 1 gal. of the Oil.

Courtesy Eastern Refractories Company, Inc.

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SUN DIESEL LUBRICANT...

Keeps Engines Running Twice As Long Before Bearings Are Scraped and Refitted

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When a Sun Engineer recommended a Sun Diesel Lubricant, specially refined for that particular type of operation, the Diesels subsequently were able to run twice as long between shutdowns.

The Engineer in charge now reports that the oil stands up and retains its clean appearance during operation. Heavy carbon deposits are no longer a problem.

This case, from the Sun industrial files, is typical of the ways in which Sun products contribute to higher production at lower cost.

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Free-Piston

(Continued from page 73)

a change in stroke for different outputs.

Advantages of Variable Stroke

Many new conceptions are thus introduced, according to J. G. Coutant.[2]

In a variable-volume engine, a constant air-fuel ratio and constant pressure and temperature may be maintained regardless of load. Increase in volumetric efficiency, while not in direct ratio to thermal efficiency, produces an increase in thermal efficiency—more power for less engine weight.

Air compression in the free-piston engine occurs first in the compressor cylinder, again in the power cylinder on the return stroke of the piston. This stroke is shorter as load increases, allowing increased space in the combustion cylinder for injection of more fuel, also maintaining normal ignition pressures and temperatures from no load to full load, as indicated in Fig. 5.

Since scavenging pressure and volumetric efficiency increase with the load, the same final compression is reached for ignition at all loads and is accurately and automatically controlled by the air cushions H and I. The indicator diagrams of Fig. 3 are for a machine supplying exhaust gas at from 15 psi gage to 75 psi gage.

High Piston Speeds

In the free-piston machine, velocities and combustion rates must be high, hence the heat energy must be utilized as rapidly as possible and the pistons must therefore be able to operate with the highest possible rates of acceleration and deceleration at the ignition and exhaust points. In a crank type of engine this is very difficult, but in a free-piston engine it is possible to get such high piston velocities. These high velocities reduce the radiation losses to cooling water and permit free gas expansion and rapid utilization of combustion energy.

Present free-piston engines supply their output of exhaust gas in the form of a mixture of compressed air and exhaust gas at about 930 F and about 70 psi gage. Performance of the combustion cylinder of the free-piston engine, to produce such output of exhaust gas, as compared with the performance of the combustion cylinders of aviation and industrial Diesels, is shown in Fig. 7. The aviation engine in question is an opposed-piston Diesel.

Fuel for the Free-Piston Engine

Up to the present time, the free-piston engine has burned Diesel oil as its fuel. In view of the progress now being made[3] in adapting pulverized coal to the gas turbine, however, there is good reason to believe that ultra-fine pulverized coal could be successfully burned in the free-piston engine combination cylinder. The possibility of producing such pulverization by use of attrition-type air mills, such as the Stephanoff mill, which pulverizes certain cosmetic and pyrotechnic materials to a fineness of 90 per cent through a 325-mesh screen, is now being studied. Since the free-piston unit employs compressed air for scavenging, complete fly-ash removal should be attainable. It will be remembered that Diesel engines have been operated for long periods with pulverized coal, as in the work of Pawlikowski.

Data on Typical Free-Piston Engines

Thermal efficiencies approaching 50 per cent are attainable with the free-piston gas turbine cycle, with compact, light, inexpensive equipment. Designs for marine power plants show a space saving of 50 per cent or more as compared with conventional steam power plants.

Numbers of free-piston compressors and engines have been built. One early machine, reports Coutant, operating as an air compressor only, attained an average overall efficiency of 22.75 per cent at 600 impulses per minute. Another installation, reported by S. A. Tucker, is composed of three cylinders in parallel, the pistons operating at 350 cycles per minute, supplying exhaust power gas to a gas turbine for a net power output of 7000 bhp, with an auxiliary turbo-compressor for charging the unit. This installation is set up for early testing by Sulzer in Switzerland.

A Pescara free-piston generator combined with a gas turbine, Coutant reports, has operated with an oil fuel consumption of 0.335 lb per bhp and efficiency of 42 per cent.

Details of a German-manufactured free-piston air compressor captured from the Japanese are shown in Figs. 2, 3, 4 and 6. As reported on by the Engineer Board for the Office, Chief of Engineers, War Department, the compressor is cylindrical in form, completely enclosed and very compact in construction. The illustrations show how it is divided into three sections, the engine cylinder at the center and the compressor sections at each end.

The combustion cylinder is equipped with interchangeable cylinder liner in which the two free pistons operate. Absence of valves and complicated valve gear, and of the conventional crankshafts and connecting rods, makes for simplicity and compactness. Fuel is supplied to the cylinder through an open nozzle of the Junkers design.

Compressor pistons also operate in interchangeable liners. On each air compressor side there are two pressure stages. All suction and discharge valves are of the same size and type, as shown in Fig. 6, and are of the fully automatic, spring-loaded plate type.

Construction and design have minimized vibration to such an extent that installation without a foundation is possible. The construction should simplify servicing and maintenance, says the report, and the weight is reduced to a surprisingly low figure.

The Board believes the Japanese may have used such a compressor in a submarine or as a source of high-pressure air for flame-throwers or oxygen plants. Recommendation is made that the principles employed in this type of compressor be given further consideration for general military use and specifically for use with the new type liquid-gaseous oxygen plants proposed for standardization by the Corps of Engineers.

[3] The Coal-Burning Gas Turbine for Locomotive Use; J. I. Yellott and A. D. Singh; POWER PLANT ENGINEERING, August, 1945.

Mass Spectrometer as a Tool for Research

The Mass Spectrometry Section of the National Bureau of Standards is an outgrowth of war work that is being continued as a part of the regular organization. Extensive use is being made of the mass spectrometer as an instrument for the quick, convenient analysis of a wide variety of gases and volatile liquids. The sample required for analysis is very small —only a cubic millimeter of gas or vapor — and complex mixtures of closely related organic substances can be analyzed with speed and accuracy unattainable by conventional means.

The mass spectrometer has been used in connection with the Government synthetic rubber program for a variety of purposes, such as determining the composition of feed stocks and intermediates in the production of butadiene, ascertaining the losses of butadiene in vent gases, and finding the purity of isoprene, butadiene, styrene, and other monomers. The purity of specification grade butadiene can be found with a high degree of accuracy by measurement of the freezing point.

The molecular structure of high polymers, such as synthetic rubber and plastics, is being studied by subjecting the polymers to thermal decomposition and analyzing the resulting products by means of the mass spectrometer. In a classical study of the thermal decomposition of natural rubber, conducted several years ago by the late Thomas Midgely, 200 pounds of crude rubber was broken down by destructive distillation in order to get enough of the decomposition products to separate and identify them by the then available means. In the current work, a sample of only a few milligrams—a millionth as much as was required by Midgely—is decomposed in a few minutes in a very high vacuum and the analysis is made and computed within a day or two instead of several months.

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Built in globe and angle designs, from ¼ in. to 2 in. sizes, with screwed or socket welding ends. Deliveries can ordinarily be made from factory stocks.

Fig. 2698—Globe, inside screw, 600 lb sp.

Fig. 2699—Angle, inside screw, 600 lb sp.

Similar design, O.S. & Y. type, also carried in stock.

For design and dimensional details on these and other Edward steel valves, write for Catalog No. 103.

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1. Low Pressure Drop—You can use smaller pipe sizes.
2. EValloy Stainless Steel Seats and Disks Borized in Mated Pairs.
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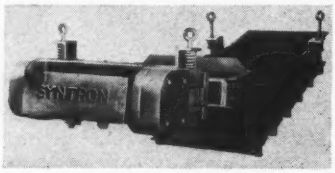
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Vibrator Screening Grizzly

AN ADDITION to its line of vibratory feeders has been made by the Syntron Co., 494 Lexington, Homer City, Penna. The type of construction is reported by the company as responsible for some of its advantages. The full length of the grizzly is utilized for material separation and discharge because the pulsating magnet is forward and above the grizzly deck. The



actual conveying or feeding is restricted to over-size material—the bulk of the fines being vibrated through at the rear of the trough upon introduction to the feeder.

While not perceptible to the eye, the vibratory motion is actually "upward, forward and back" momentarily leaving the material suspended, then repeating this movement 3600 times per minute. Thus, some impact is occasioned between the material and the grizzly bars. This impact, while slight, is of sufficient force to tumble the material and hasten separation.

Jet Shaft Sleeves

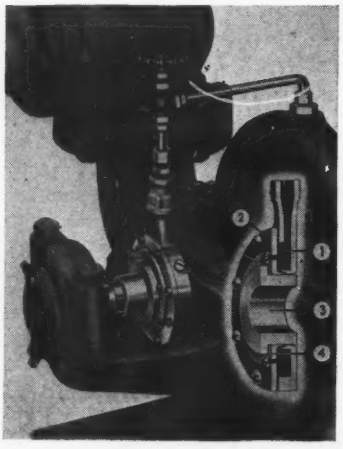
FOR SEALING OFF internal pumps pressures, the use of a simple liquid jet has been employed with exceptionally good results, according to the manufacturer, Jet Shaft Seals, Inc., 1452 S. San Pedro St., Los Angeles 15, Calif. It is claimed that abrasives, acids and caustics can be handled as easily as clear water and expensive liquids can be sealed within the pump, without waste and salvage.

Application of this jet principle to the pump seal is announced as commercially new but thoroughly tried and tested. In solving the packing problem wear has been reduced to a minimum on sleeves, shafts and wearing rings, and the reduced friction increases the overall efficiency of the pumping unit.

Jet shaft sleeves are designed to replace the usual packing and packing gland which is done by either drilling and tapping four holes in the face of the stuffing box or securing the present packing gland bolts through the standard lugs on the seal.

In operation, liquid being pumped is piped at full discharge pressure from the pump casing to the seal where it flows through the liquid box (1) to the orifice plate (2) and through the orifice into the suction space in the pump, sealing off internal pressures. The shaft sleeve (3) turns with the shaft and a clearance of 0.02 in. is allowed between the shaft sleeve and the orifice plate. A neoprene diaphragm (4) seals the pump when not in operation as the pressure within the pump seals the diaphragm against the shaft sleeve.

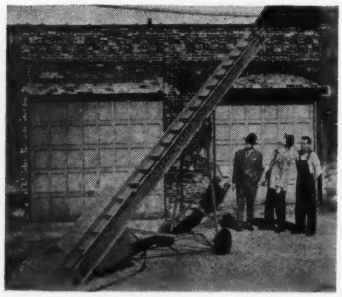
These seals are made of cast bronze and stainless steel, giving a choice to suit best the conditions of service. They are available in shaft sizes from 1 to 2¾ in. diameters.



Elevating Frame for Portable Conveyor

FOR DOING an efficient materials handling job where height is a problem, the American Conveyor Co., 1115 West Adams St., Chicago 7, Ill., announces High-Boy, the latest improvement to its line of portable electric conveyors.

This attachment is built to fit any machine in the American Conveyor line, 8 and 12 in. widths, 13 and 20 ft lengths. With the new High-Boy



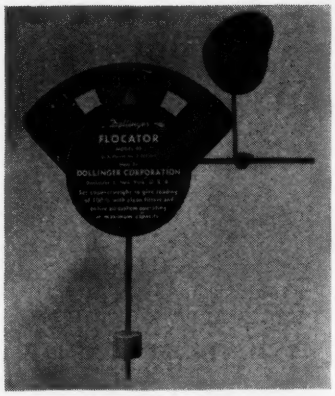
it is possible to raise the conveyors over 12 ft, making it easy to work stock piles in coal yards, unload and load materials from box car to bin or loading platform or stack many kinds of bulk and package material.

Features of the new High-Boy include: ease of attachment, iron frame, safety stop, sprocket and roller chain winch, pneumatic tires, roller bearings, and perfect balance. It will carry a load of 1500 lbs.

Air Flow Indicator

NOW IN PRODUCTION at the Dollinger Corp., Rochester, New York, is the Dollinger Flocator, a new air flow indicating instrument. It was designed for use in any air ventilating system.

The instrument is designed to require little or no attention for continuous operation. It supplies information, at all times, on the percentage of maximum flow being obtained.



The Flocator, it is reported, will warn against any loss of air flow in a ventilating system from any cause whatsoever, thus preventing circulation loss which will in turn lower operating costs. It is being manufactured in two models, Model 45 for small capacity ventilation, and Model 75 for large capacity systems.

Non-Skid Floors

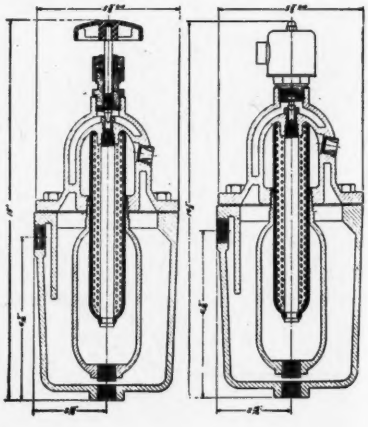
THE STONHARD CO., 401 North Broad St., Philadelphia 8, Pa., has perfected a semi-plastic non-skid coating for wood, cement or metal floors that are subjected to heavy abuse. It may be applied with brush or trowel making it possible to place where clearance may be as little as 4 in., just high enough to handle the trowel.

It will withstand light trucking and its finish is fine enough so as not to accumulate dirt and dust making it sanitary and easy to clean. Attractive color schemes can be followed or worked out with its range of five colors.

New Humidifiers

TWO NEW STEAM-TYPE HUMIDIFIERS, utilizing a venturi nozzle to discharge steam, are now in production at Armstrong Machine Works, Three Rivers, Mich.

One of the models has a solenoid valve to control automatically the discharge of steam, while the other one has a hand-operated valve to meet the need for manually controlled humidification.



One basic change has

REVOLUTIONIZED ZEOLITE WATER SOFTENING

Here's what the new Elgin means to you-

Most plants need more soft water—

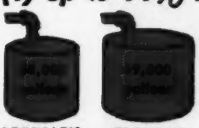
Too often the use of soft water begins and ends in the boiler room. But the extra amount of soft water that costs so little more in the big-output Elgin "Double-Check" Softener permits many uses of soft water that are highly profitable through cutting labor costs, improving processes and reducing maintenance costs. Throughout the hot water system, zero-soft water eliminates scale and lime deposits in tanks, heaters and piping, cutting plumbing costs. In all plant cleaning operations it does a better, faster job with a big saving of soap and cleaning compounds. In many plant processes Elgin "zero-soft" water improves the quality of finished products and where jacketed equipment is involved it increases operating efficiency and cuts maintenance cost.

Where corrosion is a problem, Elgin anti-corrosion treatment gives complete protection.

*** Your present softener, regardless of make, can be modernized by Elgin to incorporate the features and advantages of the Elgin "Double-Check" Softener. The new bulletin explains this.**

When we say the Elgin "Double-Check"* method has revolutionized the zeolite water softener, we simply state a fact that is confirmed by more than 3,000 of these softeners now in service. Users acclaim it; operating records confirm it! Here briefly is what the "Double-Check" Softener means to you:

(1) Up to 44% more soft water: By preventing escape of zeolite, the "Double-Check" manifold system permits utilizing a zeolite bed far deeper in proportion to the size of the softener. Likewise, by preventing escape of zeolite, a higher back-washing rate is made possible. The zeolite is kept clean and active, thus more zero-soft water is produced per pound of salt. For example, a 48″ x 72″ Elgin, softening ten-grain water, delivered 21,000 gallons more soft water per regeneration than a conventional softener of identical size.



(2) Costs less*—to buy, operate, maintain.* Based on gallons delivered the initial cost of the Elgin is lower. The "Double-Check" distributing and collecting system means less regenerating salt and wash water. Elgin quality means longer life; lower maintenance.

(3) Requires less space. The diagram tells it. This is often a vital consideration.

New bulletin *tells the convincing "Double-Check" story.* State whether you want the general power plant, laundry or hospital edition.

ELGIN SOFTENER CORPORATION

1256 NORTH ROSE AVE. ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

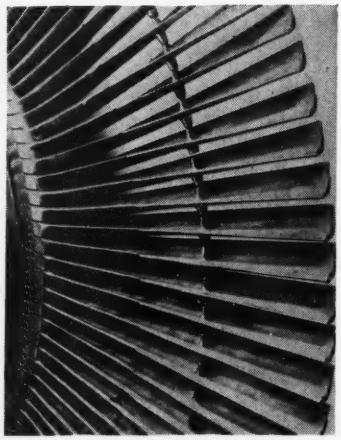
The venturi replaces an electric fan and motor used on the older Armstrong models. By virtue of fast steam discharge through the venturi, thorough mixing with the air is assured.

One advantage of these new units is simplified maintenance, since there is no motor to oil. Elimination of the motor also reduces the electrical load on the humidistat, which controls relative humidity by making and breaking an electrical circuit.

Forged Blade Lashing

BLADES IN THE last rows of a large steam turbine are long structures. They have low natural vibration frequencies and require some bracing near their midsection for tuning purposes. Heretofore they have been lashed by welding stainless-steel wires between them, or earlier, by piercing the blade and silver soldering round wires in place. There is always the possibility that the heat of the welding or soldering process may disturb, adversely, the metallurgical structure of the blade material.

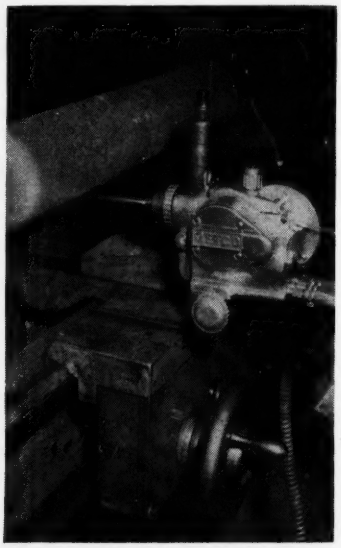
With the new type of blade developed by Westinghouse, the direct welding to the blade surface is avoided. The blade is forged with bosses or stubs at the point of lashing. Then when the blades are stacked, the boss of one blade comes adjacent the boss of its neighbor. The ends of these are then welded without transmitting the heat to the blade section.



The accomplishment in this construction lies in the forging technique. It must be done in such a way that the metal as it is formed into the boss is properly worked, not just pushed into shape.

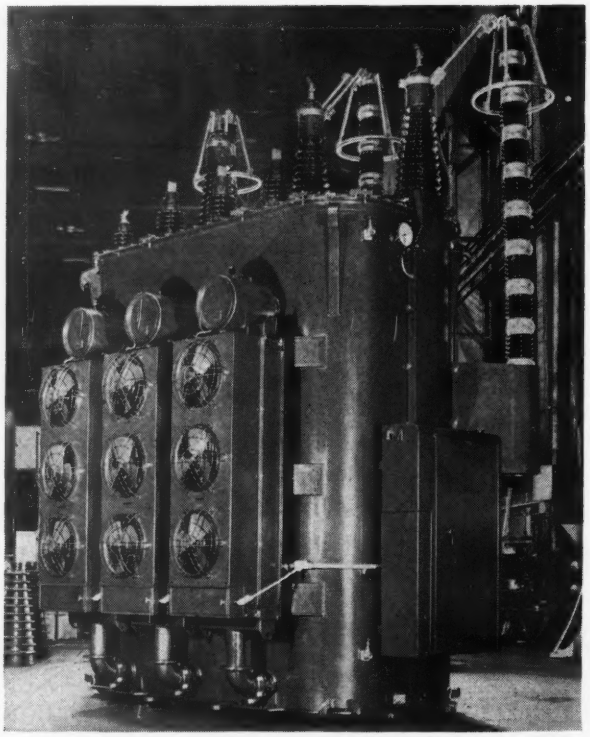
Metalizing Gun for Continuous Operation

THE NEW Metco Type Y Metallizing Gun, developed by Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y., is designed and built specifically for mechanical mounting and continuous operation. Its many outstanding features include the use of $\frac{1}{4}$ in. wire, which, when combined with an acetylene pressure of only 15 psi more than doubles any previous spraying speeds. This gun is much heavier and much more



rugged in construction than for the hand gun. Gears, worms and bearings, several times larger than any used previously, virtually eliminates wear and replacement. This coupled with lower operating and maintenance costs effects considerable savings.

Fluid lubrication and a built-in forced feed pump which has no parts to wear assures an adequate supply of lubricant to all bearings regardless of operation position. The gun is nonsensitive to gas and oxygen pressure variations as much as 10 lb either while lighting or while spraying.



Transformer With Detachable Coolers

ONE OF TWO power transformers, recently built by the General Electric Co. at its Pittsfield (Mass.) plant for the West Penn Power Co., is among the first large units utilizing forced-oil, forced-air, detachable coolers. Rated 60-cycle, 45,000-kva, 11,000 low voltage to 132,000 high-voltage, it will be used to step up power for transmission over the utility's lines out of the Springfield station. Arranged so one cooling unit is in operation when the transformer is excited, the transformer is equipped with winding temperature control which automatically regulates the operation of the remaining two units in response to increases in load. The coolers, easily detached for shipping purposes, greatly reduce the amount of radiating surface required compared with the conventional self-cooled radiators.

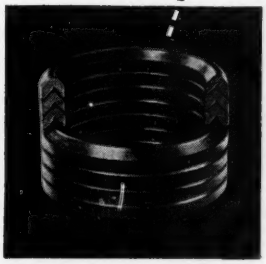
Blow-Down Separator and Muffler

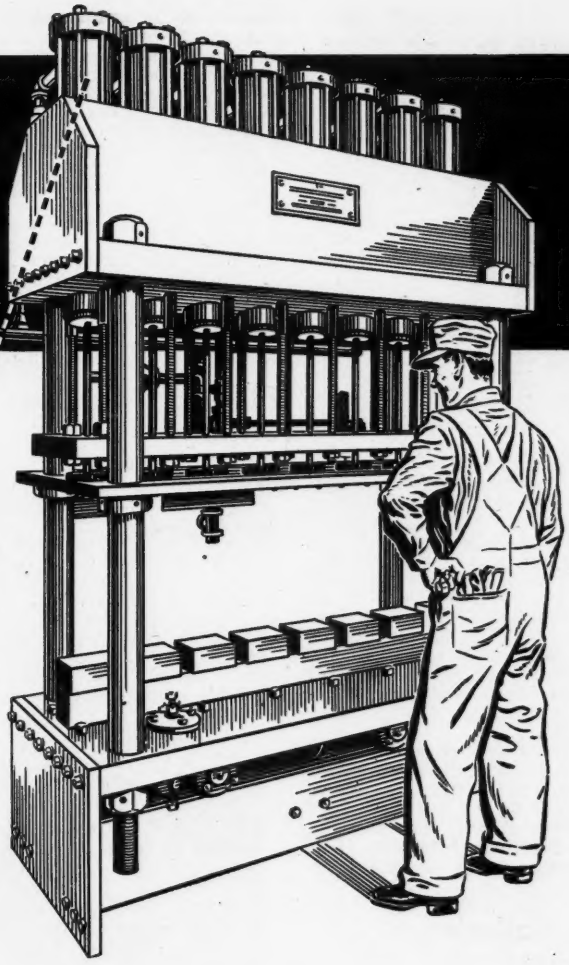
THE CENTRIFUGAL blow-down separator and muffler, developed by Wilson Engineering Co., 122 S. Michigan Avenue, Chicago 3, Ill., serves adequately as a substitute for the blow-down tank.

This type of separator and muffler was originally designed for locomotive use, and was later adapted to meet stationary boiler installation requirements. It was considerably improved, however, for the latter service, in that vertical clearances are not limited, as they are in the case of locomotives.

IT'S LOADED

by Hydraulic Cylinders Packed With R/M Hydraulic Rings





Over and over again engineers, like the one in charge of the loading-machine above, report: "1. Performance good. 2. Holds up well despite foreign matter in fluid. 3. Easy to install."

R/M makes a dozen different types of packing for hydraulic cylinders, each in a wide range of sizes . . . V-rings . . . metal-reinforced rings . . . rings for air, oil, water.

R/M hydraulic packing was used throughout the war in thousands of munitions-loading machines; is used now in thousands of peacetime applications in hydraulic cylinders on lifts, hoists, rams, controls, motors, all kinds of specialized machines.

R/M hydraulic packings are just part of R/M's complete line for all packing needs . . . for pumps, valves, compressors, pressure vessels . . . for long, economical service at extreme temperatures and pressures, or handling corrosive and poisonous fluids. See your R/M distributor for the R/M packings made for your particular needs.

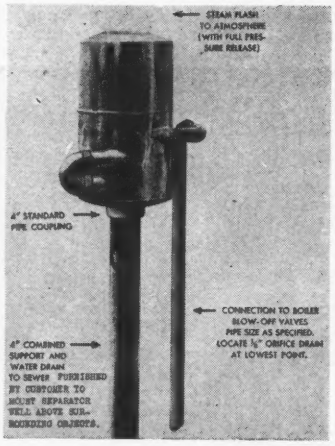
It's "Packed with Satisfaction" when you use **R/M**

RAYBESTOS-MANHATTAN, INC.

ASBESTOS TEXTILE AND PACKING DIVISION

Manheim, Pa. • Bridgeport, Conn. • North Charleston, S. C. • Passaic, N. J.

RAYBESTOS R M MANHATTAN


STEAM FLASH TO ATMOSPHERE (WITH FULL PRESSURE RELEASE)
4" STANDARD PIPE COUPLING
CONNECTION TO BOILER BLOW-OFF VALVES PIPE SIZE AS SPECIFIED. LOCATE ½" ORIFICE DRAIN AT LOWEST POINT.
4" COMBINED SUPPORT AND WATER DRAIN TO SEWER FURNISHED BY CUSTOMER TO MOUNT SEPARATOR WELL ABOVE SURROUNDING OBJECTS.

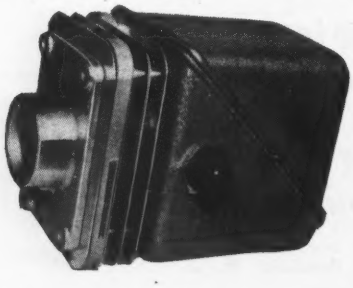
In operation the blow-down from the boiler connection is jetted tangentially into the separator and muffler. A vortex is thereby created which allows the steam to pass off vertically and quietly through an adequate opening to the atmosphere. The water and sludge are carried into a chamber beneath the separator; thence to the sewer through the supporting pipe. Since the pressure is all carried off with the steam flash through the top opening, the flow to the sewer is by gravity only, and is, therefore, not objectionable.

The device is not a pressure vessel, the large opening at the top prevents accumulation of any pressure beyond that generated by the jetting effect of the blow-down stream. The water and sludge are discharged by gravity alone to the sewer or other convenient disposal.

Flame Failure Safeguard

FIREYE FLAME-FAILURE SAFEGUARD Type F18T is designed to provide explosion protection for all industrial and commercial oil and pulverized coal burners. Fireye works on the photo-electric principle. When flame fails, it instantly cuts off fuel and sounds an alarm.

This instrument has been designed by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., to meet the requirements of the industrial user as well as the burner manufacturer. It consists of a phototube and amplifying system, housed in a dust-tight aluminum case. The entire control is mounted directly on the furnace wall within five feet of the flame which it is to monitor, and is alined in a manner which permits the photoelectric cell to observe the flame through a 2 in. pipe connection which serves as both a sighting tube and a support for the equipment.

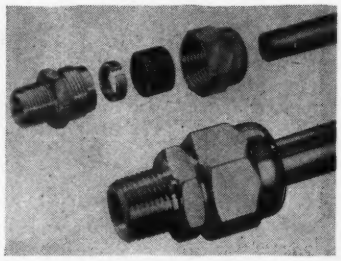


A clear pyrex filter keeps the equipment dust-tight and is mounted on a hinged shutter which permits it to be cleaned without shut-down. A heat-absorbing filter in the lens system as well as an efficient baffle system protects the instrument from all radiated heat. The specially designed phototube permits operation at high ambient temperature.

Other features include a pilot light which can be viewed through an angle of 180 deg, and a time delay element which prevents the relay from dropping out during purely transient flame disturbances. Fireye operates on 115 to 230 v, 50 or 60 cycle a-c and consumes 10 w. Its weight is 12½ lb.

Flexigrip Tubing Fitting

FLEXIGRIP TIME-SAVING tubing fittings which eliminate end preparation or soldering of the tubing and yet produce a stronger, leak-proof and flexible joint have been announced by Gustin-Bacon Manufacturing Co., Kansas City, Mo. This new fitting, made in standard sizes from ⅛ to 1½ in. O. D., consists of four parts—the body, a gripping ring, synthetic rubber gasket and nut. To attach the fitting, the nut (with gasket and ring inside) is slipped over any plain-end

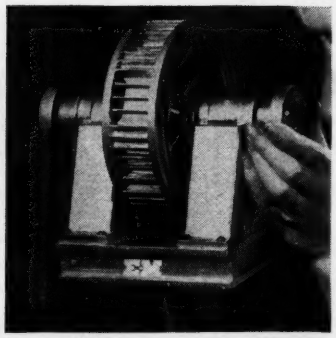


tube, cut to desired length. The tubing end is inserted into the body as far as it will go and the nut tightened. Tightening the nut compresses the ring into a tight grip and moulds the gasket around the ring for a leak-proof seal that is so flexible it will withstand unusual vibration or impulse.

By the elimination of flaring, swedging, or soldering, the tube end adds considerably to the strength of the joint as well as saving time and labor. Economies in time and material are also considerable over the collar, ring or ferrule type of tube-end fitting. Flexigrip tubing fittings are available in brass, aluminum or steel.

Magnetic Adjustable-Speed Drive

PRECISE, WIDE-RANGE, quick-response speed control for boiler draft fans, centrifugal pumps, blowers and compressors is provided by the new magnetic adjustable-speed drive, developed by Electric Machinery Mfg. Co., Minneapolis 13, Minn., and shown in miniature in the accompanying model. Consisting of but two operating parts, a rotating ring and a rotating magnet, the magnetic drive is a compact, self-contained, electro magnetic torque transmitter used in combination with



a constant speed a-c motor and an electronic controller to provide split-revolution speed control.

Built in ratings approximately 25 hp and larger at 1800 to 600 rpm, the magnetic drive is available in several forms to meet the requirements of new or existing installations. The magnetic adjustable-speed drive provides substantial power savings by operating boiler draft fans at reduced fan speed for partial fan output, eliminating the need for damper or inlet vane control. Life of induced draft fans operating in erosive gases is greatly increased due to use of reduced speeds at partial fan outputs.

The magnetic adjustable-speed drive can be used in combination with synchronous motors to provide power factor correction.

Valve Control Assembly

BY FACILITATING immediate control of valves in hard-to-get-at places, a remote valve control assembly recently developed by J. A. Zurn Mfg. Co., Erie, Pa., provides a high margin of pipeline safety. From one easily accessible control board, valves can be opened and closed with a minimum of delay.

Those assemblies easily operate and control valves located below floor level, close to the ceiling or walls and partitions, inside tanks or processing vessels, or in the midst of complicated installations of piping and equipment. The assembly consists of a flexible cable, for transmitting torque to the handle of the valve to be operated, or a rod or pipe connected by universal joints; a remote valve control box, the cover of which can be engraved to identify the type of valve it operates; sleeve bushings, terminal brackets, cable clips and a rod coupling for the valve wheel.

The valve control boxes are made in cast bronze, steel, semi-steel or iron of various dimensions, and can be attached to masonry construction, metal or wood partitions.

Air Separator

UNDER TRADE NAME Airfuge, a new separator for removing moisture, oil, scale, etc., from compressed air is announced by The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

Utilizing the centrifugal principle which has characterized steam and oil separators made by this company, the new product features simplicity of construction and operation and highly efficient separation. Repeated tests show that air delivered by the

More tons of "know-how"—

ASA Standards cover welding flanges only in sizes through 24", but when a flange becomes part of a pressure vessel, big ones like this are often required. And when you see one of these big ones you can be pretty sure it was made by Taylor Forge because we have been the leading suppliers of such flanges for the manufacturers of pressure vessels for more than 25 years.

Of course the problems attending the design and fabrication of boilers and other pressure vessels merge with and overlap those in the piping field. So the knowledge gained in working with boiler manufacturers has made a vital contribution to our knowledge of what constitutes good piping design.

THE knowledge of piping design and related forging technique accumulated through years of solving all kinds of unusual problems has been drawn upon fully in the design and manufacture of our standard line of WeldELLS and other Taylor Forge fittings for pipe welding. It has resulted in fittings of advanced engineering design with features which add to their strength, service life and convenience—others that speed up the job and lower the cost of pipe installation.

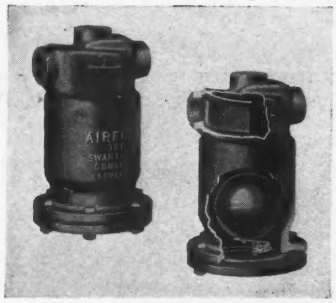
Check the features of WeldELLS listed opposite. Here are features that are not combined in any other welding fittings. Surely you want every one of these features in *your* welding fittings. You get them only in WeldELLS and other Taylor Forge fittings, for in the opinion of those best qualified to know, WeldELLS alone "have everything"!

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



Swartwout Airfuge is 99 per cent or more free of contamination.

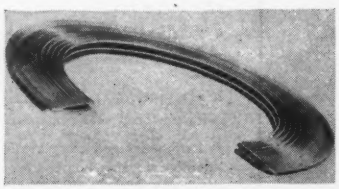
Air entering the inlet is diverted positively to the inner wall of the round body and unwanted substances whirl out of the air stream and drain to the bottom. The cleaned air may be taken off horizontally or vertically from pipe-tapped ports. An integral float-operated trap releases condensate automatically.

The separator is made of high-tensile iron; interior parts of corrosion-resisting materials. Bottom is easily removed if necessary for cleaning. Three sizes are available for varying capacities and with a range of pipe connection sizes.

Pressure Sealed Gasket

EMPLOYING THE PRESSURE to be sealed to exert a corresponding sealing pressure on the flange faces, Goetze Gasket & Packing Co., Inc., of New Brunswick, N. J., has introduced on the market a serrated type gasket, known as Bellowseal.

This gasket consists of two discs of metal (Armco iron, low carbon steel, Monel or stainless steel) machined on



their external faces with standard serrations and welded together around their outer periphery.

It combines the pressure and corrosion resistant qualities of all metal gaskets with the light bolting requirements of a softer sealing medium. Line pressure entering the interior of the gasket exerts expansion pressure in excess of the required sealing force.

Gas Detection and Analysis Instruments

THE DAVIS EMERGENCY EQUIPMENT CO., INC., 45 Halleck St., Newark 4, N. J., has announed an extended line of gas detection and gas analysis instruments. These are the result of the recent granting of the exclusive license to manufacture and sell special thermal conductivity cells under W. O. Hebler Co., patent.

This new line of instruments which will also include the previous Davis line of combustible gas alarm systems, will include safety equipment for the detection and analysis of combustible gas or vapor in air for the measure of gas or vapor air mixture from the characteristics of explosion. It will also detect and analyze any one gas, whether combined or not with other gases.

Detection and analysis of any one gas in a binary mixture, for gas purity or gas proportioning, will also be possible, as will similar detection and analysis of any one gas in a complex mixture with all gases varying. The analysis of flue gas and exhaust gas will be possible with the new instruments.

All of the new line of instruments will be available with direct reading meters, or circular chart or strip chart recorders, or with recording and control equipment.

Protective Coating

A NEW PROTECTIVE coating Cotoid, described as being highly resistant to acids, alkalies, chlorides, oils, brine, oxygen, gasoline and alcohol solutions has been developed by the Lithgow Corp. 333 W. 40th Place, Chicago 9, Ill. This is based on synthetic resin—a thermo-plastic—in which its low water absorption and inert properties tend to inhibit corrosion.

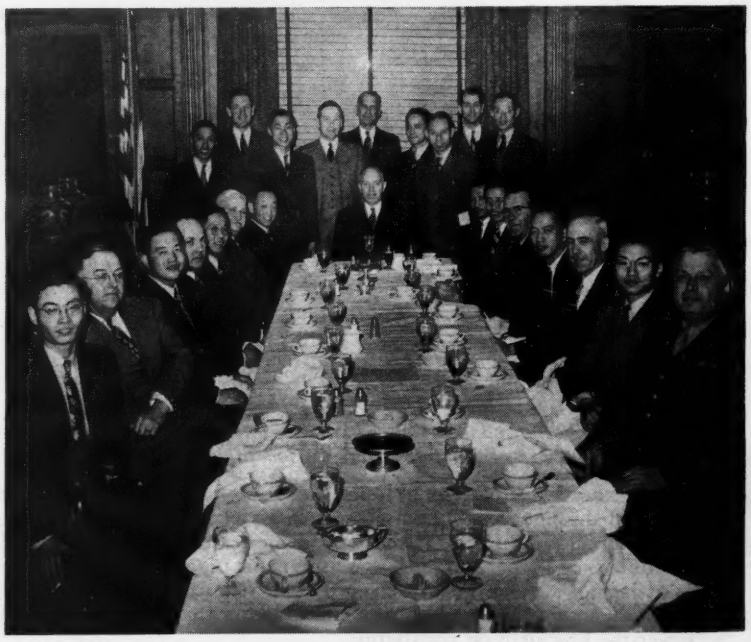
The application of Cotoid results in a tough, hard, elastic finish, which after air or force drying, is tasteless and odorless. It has been found practicable for protecting walls, wood or steel structural work, in food processing plants, wineries, breweries and paper mills. It can be used for coating inside and outside surfaces of concrete, steel or wooden tanks used for corrosive solutions, brines and alkalies. The manufacturer points out that it has been laboratory tested and approved for use with a wide range of acids, gasoline, sour crudes, and lye solutions.

It will withstand a maximum temperature in air or vapor of 220 F. It is said to not crack under temperatures as low as 20 F.

New Floor Cleaner

FLOOR CLEANER No. 1F10 has been announced by Optimus Detergents Co., 240 Church Street, Matawan, N. J. This product is a heavy duty floor cleaning compound, especially compounded for use on cement, Terazzo or tile floors.

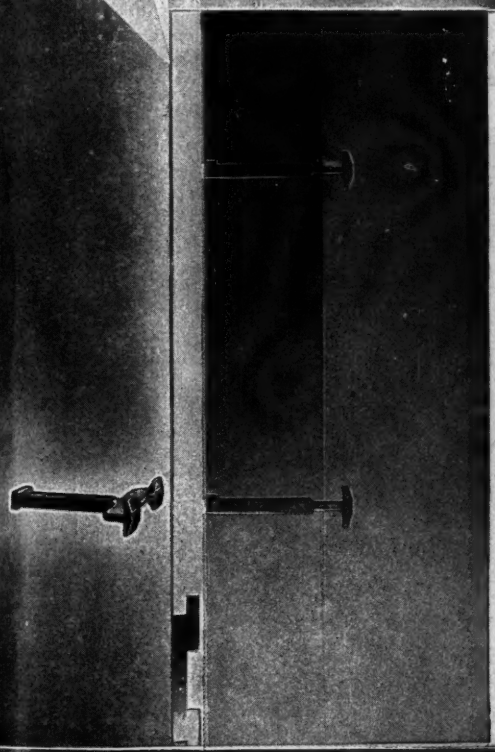
It is pointed out by the manufacturer that, although effective in removing oil, grease and other dirts from the surface, this material does not harm the finish in any way. In fact, it is said, regular washings with the cleaner helps keep floors in good condition, makes them less porous, keeps them from dusting, keeps them whiter and cleaner.



Chinese Engineers Guests of Detroit Edison

ONE OF THE IMPORTANT features of the regional meeting held during the Christmas Holidays in Detroit by the Chinese utility engineers was the Christmas dinner given by The Detroit Edison Co. These engineers have been sent to America under the International Training Administration program as representatives from China whom their government wishes to bring up to date on modern power plant practice. They are assigned to different utility companies in the United States, including Detroit, Chicago, Cincinnati, South Bend and some industrial plants such as Dodge. Shown in the picture here are mechanical, electrical and combustion engineers from various industrial works in China who are conferring with Detroit Edison officials.

SECTIONALLY SUPPORTED WALLS AND ARCHES DESIGNED TODAY FOR TOMORROW'S NEEDS



The principle of integrated design that employes each element for its best function is the result of 30 years' concentration on the one problem of enclosing heat.

Streamlined supporting units tie in the refractories and the insulation yet transfer only a trickle of heat. Detred Tile, intermeshed for tightness, present a smooth front to the fire . . . and plastic outside casing, applied with a trowel, seals the enclosure and provides a weatherproof exterior.

This is the kind of a wall you want on your present and projected equipment. Learn the details from our 80-page book entitled "Furnace Enclosures," available on request. Let our engineering department check your blueprints for the possibilities of modernizing.

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USE DETRICK INSULATION . . . *PLASTIC or BLOCK*

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WELDED PRODUCTS by Vogt

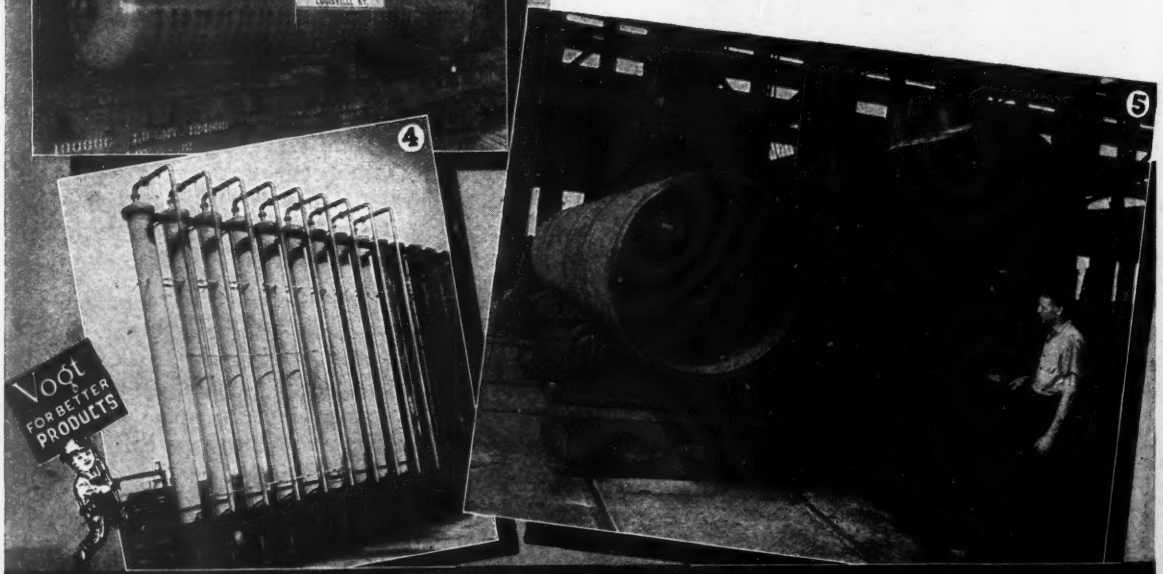
1 - 4'—0" dia. x 7'—6" dia. x 82'—5" high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

2 - Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

3 - 48" dia. x 22'—6" long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

4 - Battery of Absorption Columns in a Western Refinery. Units are 33" dia. x 41'—0" high and were stress relieved after welding.

5 - 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.



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Incorporated
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This high pressure boiler interior has been coated with APEXIOR NUMBER 1. The photograph, taken after more than five years of service, shows that no water or steam has touched the boiler metal.

A thin, brush-applied film of APEXIOR NUMBER 1 provides positive, long-lasting protection for boiler interiors. Seeping into pores and joints, it seals off the metal surface from water and steam, effectively checking corrosion and embrittlement.

Corrosion may remain unknown and unchecked if left hidden under operating deposits. APEXIOR NUMBER 1, providing a wholly mechanical barrier, eliminates the tight chemical bonding of such deposits. Therefore, boiler maintenance is simplified — because the metal surface remains cleaner over longer periods, while its true condition is always apparent.

The tough, durable film of APEXIOR NUMBER 1, a few thousandths of an inch thick, does not retard heat transfer. On the contrary, by retarding heat-insulating layers of corrosion and sludge, it prolongs the period of high heat-transfer efficiency.

APEXIOR NUMBER 1 is applied to steam turbine shafts and rotor bodies at the factory, or during periodic inspections. It is equally effective on feedwater heaters and deaerators, Diesel engine removable liners, pump shafts and casings for high temperature boiler feed pumps, etc. Recommended by all U. S. and Canadian boiler insurance companies.

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Tanks, condensers, pumps, air washers, the submerged external areas of ships' hulls — all metal surfaces exposed to either fresh or salt water at temperatures up to 125°F. are given lasting protection with APEXIOR NUMBER 3. Tank applications are effective for every type of cold water supply, including drinking water.

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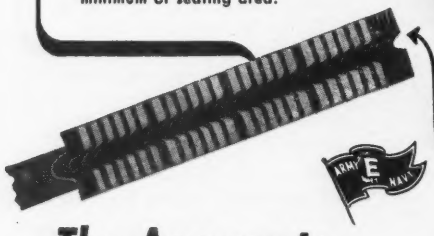
Exclusive Flexitallic "tailor-made" construction uses metal-to-metal reinforcing windings where and as needed throughout the spiral, one of many Flexitallic patented features. This provides maximum gasket strength and resiliency with a minimum of seating area.



The Answer to 1001 Gasket Problems

POSITIVE HIGH-PRESSURE INTERLOCK

Positive in its interlocking action, the Flexitallic design provides adequate resiliency for automatic adjustment of the gasket to meet changing line conditions.

Install Flexitallic Gaskets—and forget them! They're easier to install. They require no painstaking hand-finishing of seating surfaces. They automatically compensate for changing line conditions even under the highest of modern pressures and temperatures and the most severe conditions of use.

At the close of the war, more than 75% of all combat craft and a high percentage of all maritime vessels were Flexitallic equipped—convincing evidence of their dependability and uniformly precise construction. Write for catalog. Better yet, send details of your application for specific gasket recommendations by Flexitallic engineers.

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FLEXITALLIC GASKET COMPANY

8th & BAILEY STREETS · CAMDEN, N. J.

CUSTOM BUILT FOR ANY PRESSURE—ANY TEMPERATURE

ask yourself THESE QUESTIONS

Before Selecting a Piping Contractor

"Has he had extensive experience on jobs like mine?"

MIDWEST organization has erected piping for more than four decades and in that time has handled every type of piping job. Whether you have a power plant . . . a chemical or process plant . . . or whatever your piping needs may be Midwest offers you a wealth of experience on comparable jobs.

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MIDWEST plants are strategically located to give quick service to any part of the country. Each plant is a complete unit but they work together on large jobs where time limitations do not permit all fabrication in one plant.

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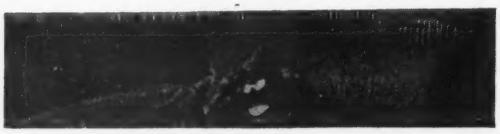
PIPING FABRICATORS AND CONTRACTORS

HOW THE ANODIC POINTS WERE CAPTURED

In many cases where a condenser tube has proven unsatisfactory in a given application, analysis of conditions will show the cause of the failure to be outside the tube itself.

A Scovill engineer was requested to explain the puzzle of the consistent failure of tubes in the first pass of a marine condenser. 18 tubes had failed in this pass, as the result of intense local pitting.

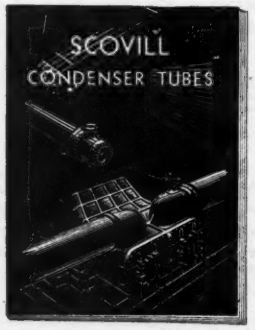


Deposits Had Done It — He found that the pitting was due to "deposit attack", an electrochemical type of corrosion initiated by foreign material lodged against the tube walls. Where such deposits covered the metal, those "islands" became anodic to the adjacent uncovered areas, with resultant intense corrosion of the anodic area. In this case, turbulence of the water passing around the deposit caused erosion-corrosion on downstream side of deposit.

Examination showed no evidence of any other type of corrosion.

The suggestion of the Scovill engineer which aided in the solution of the problem was to modify the circulating water inlet and to establish a regular practice of cleaning the tubes, using rubber plugs, bristle brushes or other equipment that would not score the tube walls.

Three Scovill Services — Scovill *Service in Men* provides specialized study and advice on individual tube application problems and on installation practices. *Service in Metals* includes production of many tube alloys, and also offers you the facilities of our laboratory to help determine the alloy best suited to your conditions. *Service in Manuals* provides valuable literature on condenser and heat exchanger tubes; for a free copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 17 Mill St., Waterbury 91, Conn.



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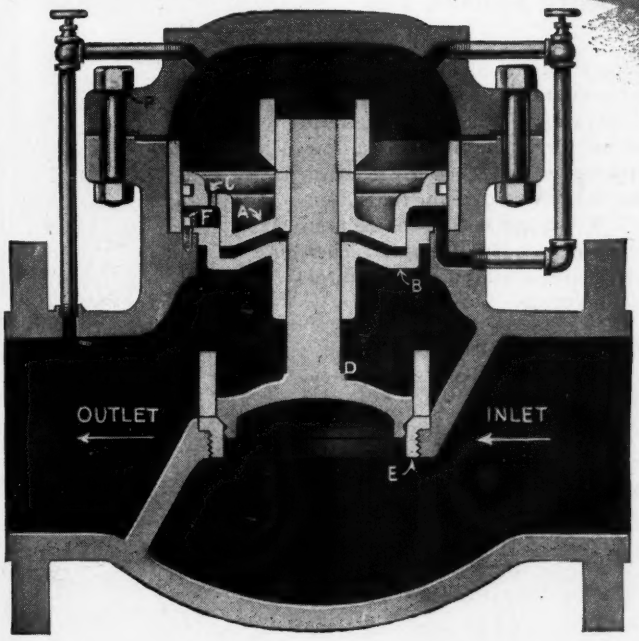
CONDENSER TUBES

Engineered PROTECTION

FOR HIGH PRESSURE BOILER FEED LINES



GOLDEN-ANDERSON HYDRAULIC *Double-Cushioned* CHECK VALVES

Look to Golden-Anderson Valves for maximum *engineered safety and protection* in your boiler room.

This valve is an excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for *any* operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14"

Other GOLDEN-ANDERSON Automatic Valves

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Princo High Temperature Thermometers offer the advantages of low cost, greater accuracy, elimination of electrical connections, and simple, maintenance-free operation. Princo high temperature accuracy is made possible by the combination of a special "combustion-type" glass, and the unique Precision pressure-filling process that insures stability of the mercury column at extreme temperatures. Princo High Temperature Thermometers are in general use for applications where low-range pyrometers were formerly required. Accuracy is uniform over the range from 30° to 1250° F. and corresponding Centigrade scale. Standard Industrial Thermometers are available in the high temperature range.

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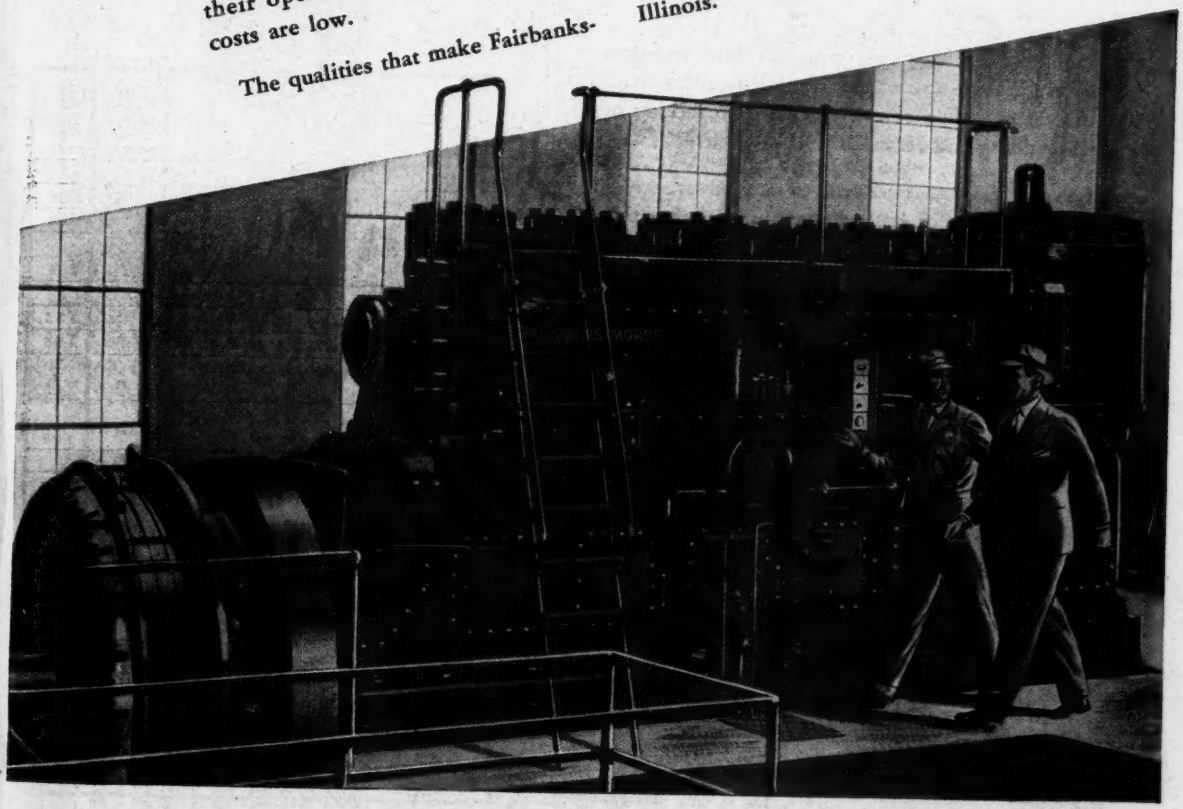

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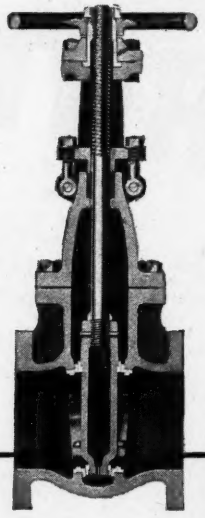
"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

Only the KENNEDY WEDGE GATE VALVE has all these features



Some of these details provide extra strength, others provide extra tightness, resistance to wear, ease of operation or convenience of repacking or dismantling and reassembly.

Some of the details are vital to satisfactory service, and others are of lesser importance . . . but they show the careful attention to every element of valve design and construction that gives you extra value at no extra cost when you buy KENNEDY Valves.

The KENNEDY Catalog describes all the special features of these extra value valves and lists the entire line of KENNEDY Iron Body and Bronze Valves for all standard pressures and services. Write for your copy today to help make a selection for trial.

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	Your Present Wedge Gate Valves	KENNEDY Std. Iron Body
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True oval body	?	Yes
Lugs on screwed ends	?	Yes
Reinforcing web an flanged ends	?	Yes
YOKE		
One-piece yoke	?	Yes
Ledges for gland	?	Yes
Separate Yoke Cap with 4 bolts	?	Yes
Lubricating hole for thrust collar	?	Yes
STUFFING BOX		
Bronze bushing in gland	?	Yes
Slotted gland on O S & Y	?	Yes
Swing bolts on O S & Y	?	Yes
Washer nuts on bolts	?	Yes
Bronze bushing at stuffing box	?	Yes
Rust-proofed bolts and nuts	?	Yes
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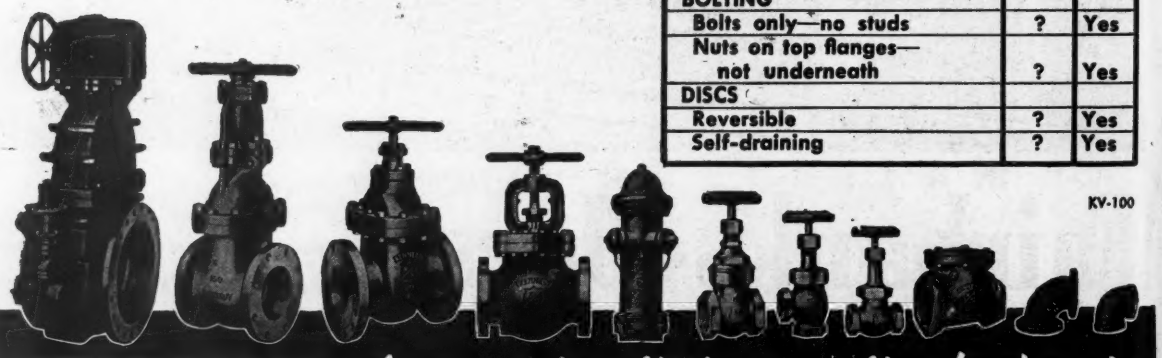
Bolts only—no studs	?	Yes
Nuts on top flanges—not underneath	?	Yes
DISCS		
Reversible	?	Yes
Self-draining	?	Yes

KV-100



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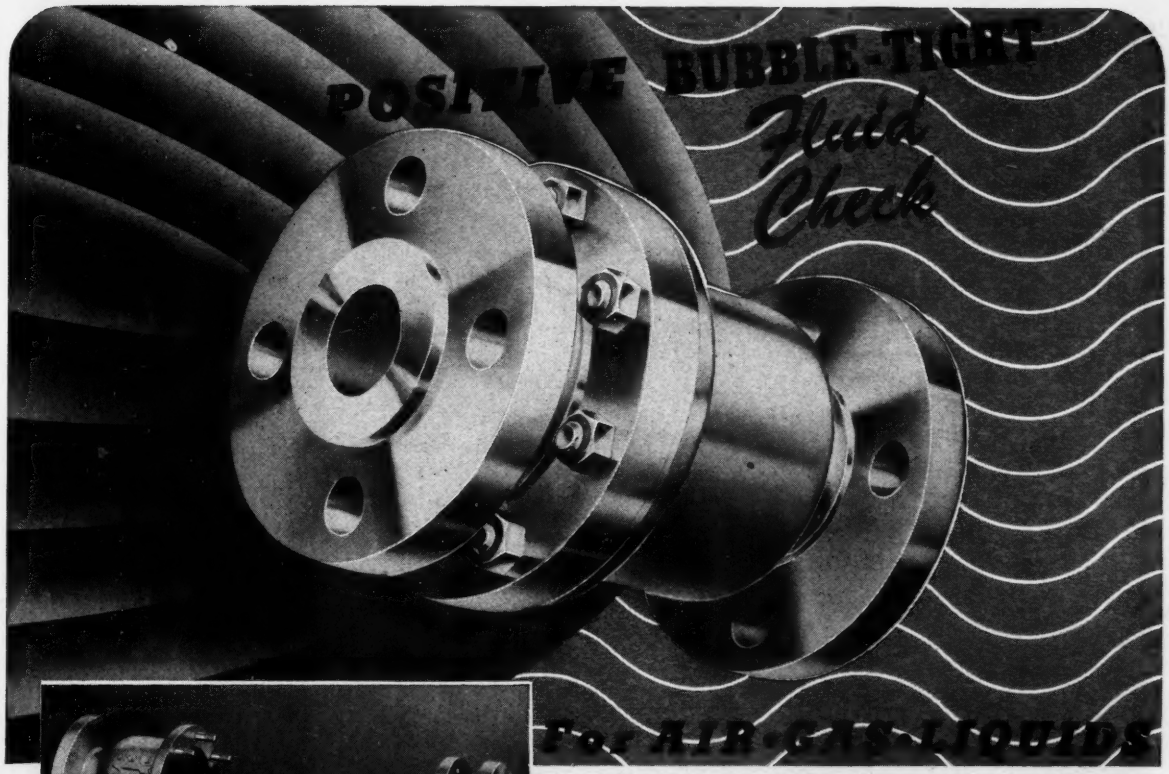

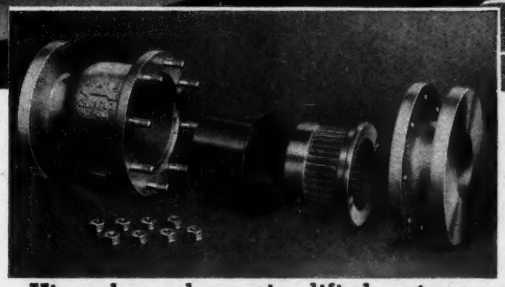

View above shows simplified parts assembly of Grove ChexFlo Valves consisting of: 1. Valve Body, 2. Flexible Synthetic Rubber Tube, 3. Slotted Cup-shaped Core, 4. Flange Closure.

- ★ Positive Bubble-tight shut-off
- ★ Instantaneous in Operation
- ★ Closes on Balanced Flow
- ★ Avoids Pressure Impulses
- ★ Self-compensating for Wear
- ★ Requires no Maintenance
- ★ Silent in Operation

EMBODIES NO METALLIC MOVING PARTS

Contrasted to ordinary check valves the Grove ChexFlo employs no metallic moving parts. Operation is effected by means of a synthetic rubber tube which expands to open and contracts to close over a slotted cup-shaped metal core. Uniform and constant spring rate of the flexible tube sets up no inertia to cause operation in excess of flow requirements. Tube closes instantly on balanced flow prior to inception of back flow. This eliminates any tendency to establish pressure impulses, shock or water hammer in flow line. For full details write for Bulletin 610 today.

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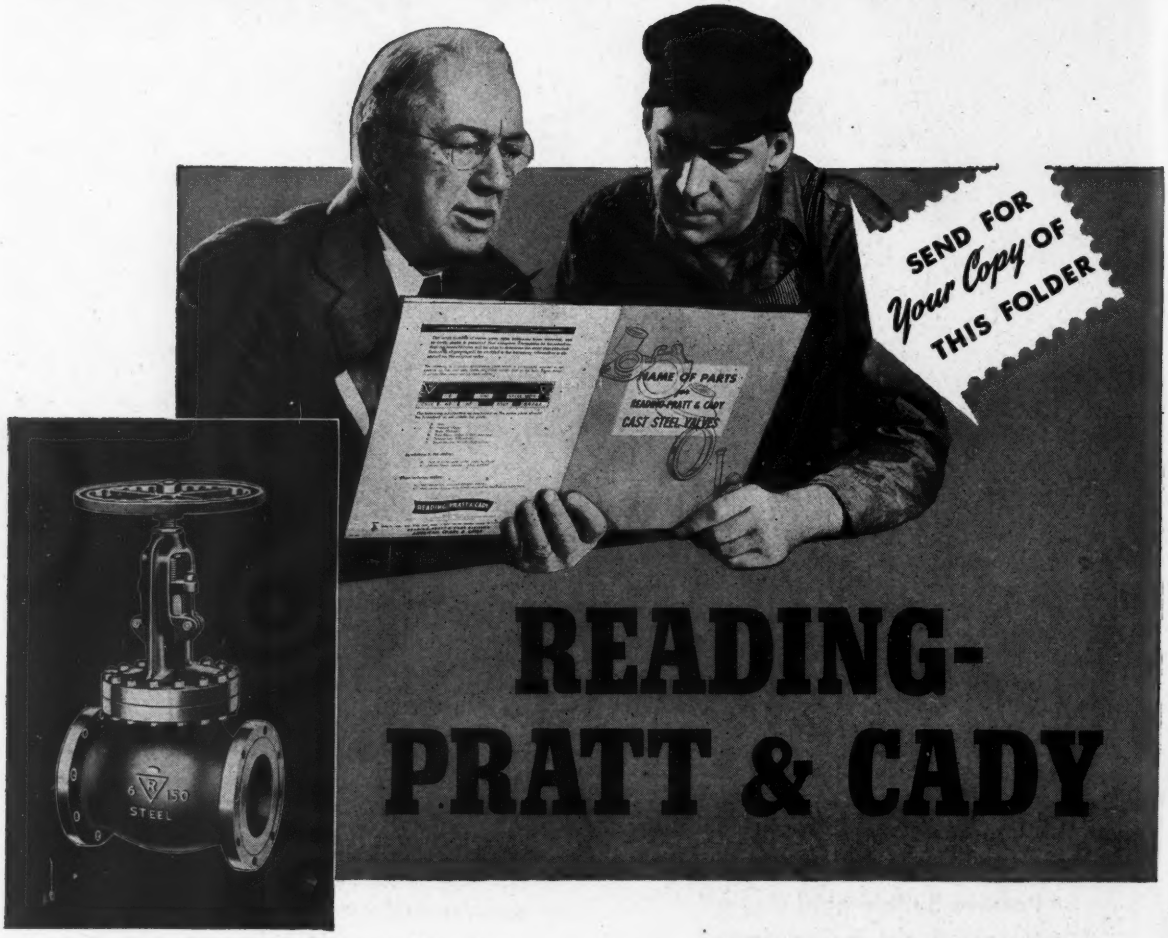

READING-PRATT & CADY

This six-page, file-size folder contains much useful information in convenient form. Here are the standard names of all component parts of steel gate, globe and check valves. Cut-away pictures make it a very simple matter to identify each part. Send for your copy.

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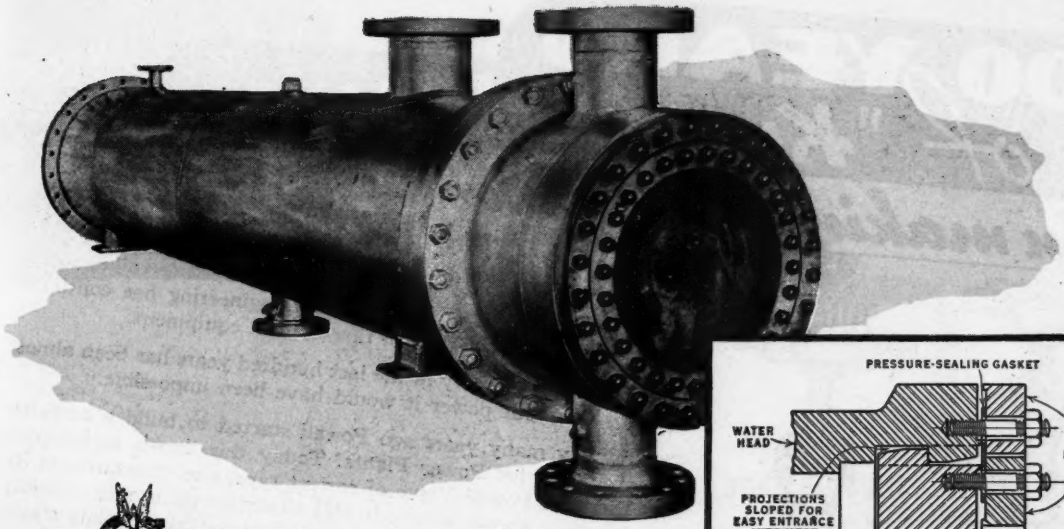

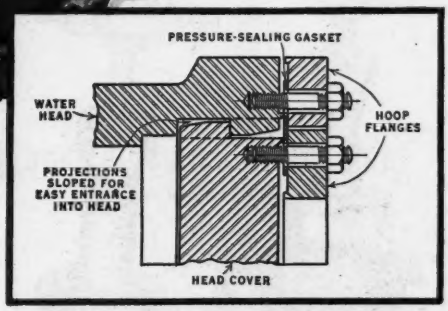

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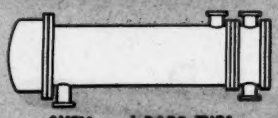
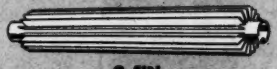
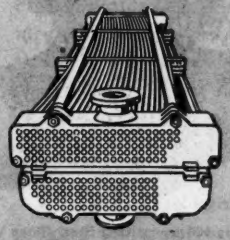


SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers



G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases



BENTUBE EVAPORATOR
Scale-shedding Elements

TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

THIS EXTRACTION STEAM HEATER HEAD

has 4 important advantages

For high-pressure service, the G-R Type L Heater Head design provides the following 4 outstanding benefits not obtainable in any other designs.

NO HEAVY BOLTS

The "breech block" arrangement of water head and cover transmits the hydraulic load to the barrel, and requires only a light pressure-sealing member to maintain a tight joint.

VISIBLE PRESSURE SEAL

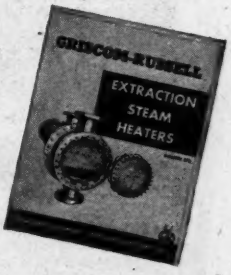
The pressure sealing joint is visible for inspection.

ACCESSIBLE GASKET

Gasket pressure is easily adjusted without dismantling the water head cover.

READILY REMOVABLE HEAD COVER

The water head cover is removed or replaced by a single tool, and by simply rotating it through a small angle equivalent to the width of the engaging "breech block" projections.



These advantages and the other distinctive features of all the G-R Extraction Steam Heater designs for various pressures and capacities are described in Bulletin 278, which will be sent on request.

THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

100 YEARS of "Know How" ..in making VALVES for POWER PLANTS

200-pound Bronze Globe Valve with union bonnet, renewable seat and regrindable, renewable wear-resisting "Powellium" seat rings and disc.

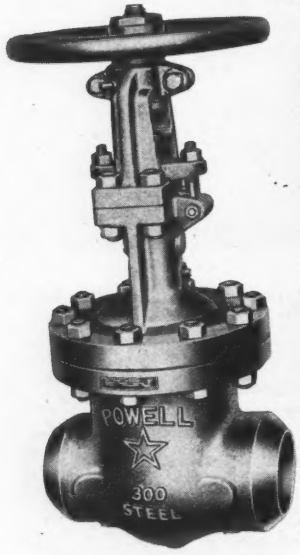
A century ago Powell started to pioneer in making valves for industry and through the years Powell Engineering has continued to lead the way in the field of flow control equipment.

The progress of industry in the last hundred years has been almost fabulous. Without power it would have been impossible.

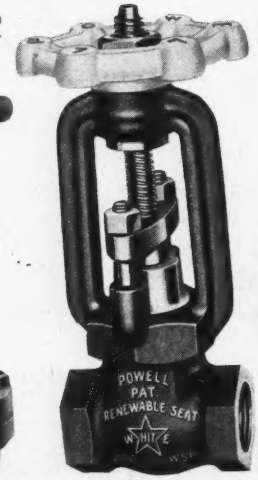
That is why many years ago Powell started to build a complete line of Valves for Power Plants. Today this line is so complete that there's a Powell Valve of correct type, size, pressure and design for every known service in this all-important branch of industry. This includes Bronze and Iron Valves for intermediate steam, oil, water and gas lines and Cast Steel Valves in pressure classes from 150 to 2500 pounds, including an outstanding line of Non-Return Valves for positive protection of boiler installations.

These are available equipped with spur gear, bevel gear or toggle operation. All Powell Cast Steel Gate, Globe, Angle and Non-return Valves can be provided with Motor Operators for remote control and quick, positive opening and closing.

200-pound Bronze Gate Valve with union bonnet and renewable "Powellium" disc.

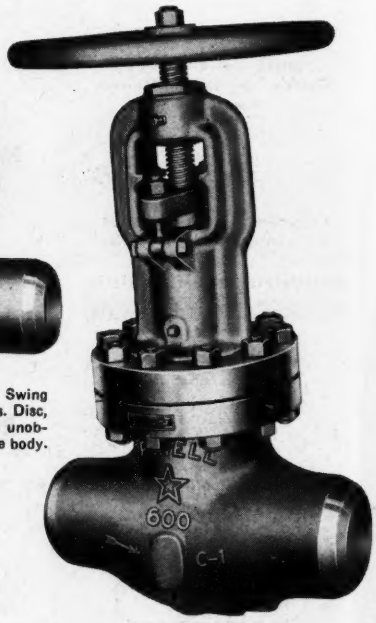


Class 300-pound Cast Steel Gate Valve with welding ends, outside screw rising stem and bolted flanged yoke.



200-pound Bronze Gate Valve with outside screw rising stem, screwed-on yoke and bonnet, and renewable, wear-resisting "Powellium" seat rings and disc.

Class 900-pound Cast Steel Swing Check Valve with welding ends. Disc, when wide open, permits full unobstructed flow through the valve body.



Class 600-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

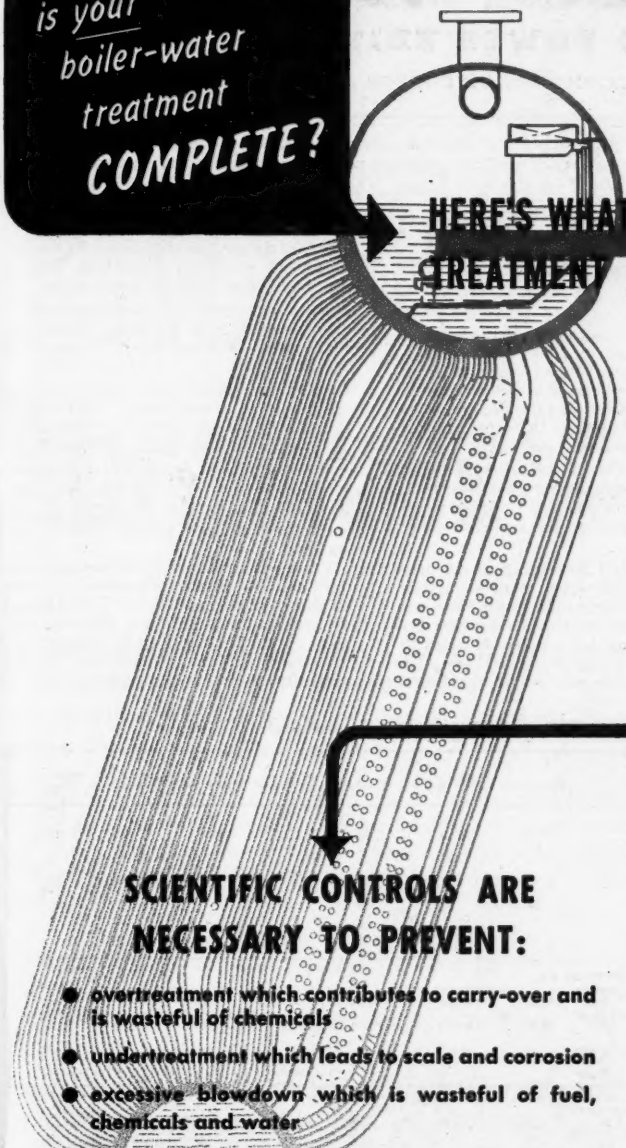
The Wm. Powell Co.

Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

is your boiler-water treatment **COMPLETE?**



HERE'S WHAT *COMPLETE* TREATMENT *MUST* INCLUDE

1. Sound Chemical Treatment
(discussed in the Febr[illegible] issue)

2. A Good Organic Coagulant
(discussed in the March issue)

3. Simple But Scientific Control

4. Competent Service & Instruction
(to be discussed in the May issue)

SCIENTIFIC CONTROLS ARE NECESSARY TO PREVENT:

- **overtreatment which contributes to carry-over and is wasteful of chemicals**
- **undertreatment which leads to scale and corrosion**
- **excessive blowdown which is wasteful of fuel, chemicals and water**

Proper water testing and control will assure satisfactory conditions—yet, procedures must be so simple that any member of the boiler room crew can easily regulate treatment and blowdown.

BUT — the finest system of control is only ONE of the four requirements for COMPLETE boiler-water treatment.

If you want to know how proper control can help prevent scale, corrosion, carry-over and fuel waste, talk it over with the DREW Man—there's no obligation!

E. F. DREW & CO., INC.
15 East 26th Street, New York 10, N. Y.

COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Porto Rico

AMEROID

THE COMPLETE BOILER-WATER TREATMENT

MAIL THIS COUPON TODAY!

E. F. Drew & Co., Inc.
15 E. 26th St., New York 10, N. Y.
I am interested in further information about COMPLETE Boiler-Water Treatment.

NAME_____
FIRM_____
ADDRESS_____

58

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Condenser and Heat Exchanger Tubes

Wide Range of Corrosion-Resistant Alloys

The selection of the most economical and satisfactory condenser or heat exchanger tubes is a problem which every power plant engineer must answer from time to time. The frequency with which this matter comes up for consideration depends upon the size and the age of the plant, and the severity of the corrosive conditions. Our object is to present information, as briefly as possible, which will help the engineer in his selection of an alloy which will give the greatest satisfaction and longest life.

During the past thirty years the replacement of corroded condenser and heat exchanger tubes has become more complicated because of the many changes which have taken place during this period. Thirty years ago there were essentially only four commercial copper-base alloys to choose from—Copper, Muntz Metal, 70-30 Brass and Admiralty. Today there are at least a dozen different alloys.

Influence of Alloy Composition

Corrosion research data show that small additions of certain metals to copper base alloys have a very marked influence on the rate of corrosion from sea water, fresh water, brackish water and polluted water. Tin, aluminum, nickel, zinc, iron, arsenic, etc., alloyed with copper singly or in combination, have resulted in the development of superior alloys.

Factors Influencing Rate of Corrosion

In a number of instances, the replacement of worn-out, corroded condenser and heat exchanger tubes with tubing made from an alloy which had previously given many years of service, has not worked out as well as expected. There are many factors which may contribute towards this situation. We find that harbor waters are becoming more and more polluted by industrial wastes and sewage. Again, operating conditions in many instances are more severe—the condenser service hours per year have in many instances been increased considerably, sometimes approaching almost continual operation. Frequently, this has a very pronounced effect on the life of the tubes, depending upon the alloy and seasonal variation in the composition of cooling water or steam. Also, greater quantities of water at higher velocities may be forced through condensers either to raise their efficiency or, in some cases, to make possible their use when larger condensers are actually needed. The use of larger capacity pumps may increase waterflow and turbulence.

In cases where chlorination is successfully practiced on old tubes, it is found that chlorination used on new tubes sometimes prevents the formation of a tenacious protective corrosion film, and contributes to premature failure. When changes in operation are contemplated, it is well to consider their possible effect on tube life and select the alloy which will be the most satisfactory one for the new conditions.

Duronze IV—One of the finest condenser tube alloys. Excellent corrosion resistance to sea water, and polluted brackish water. Highly recommended for seaboard power plants.

Cupro-Nickel 70-30—Excellent corrosion resistance to sea water; resists impingement corrosion from high water velocities. Good resistance to stress corrosion and higher operating temperatures. Most resistant of this group of copper-base alloys to the action of ammonium hydroxide. U. S. Navy specifies this alloy for war ships and other vessels.

Cuzinal (aluminum brass)—Resists impingement corrosion from high velocity and trapped air bubbles in sea water.

Arsenical Admiralty—Good general corrosion resistance to sea water. Resists dezincification. Recommended for low water velocities only.

Red Brass—Excellent-to-good corrosion resistance to most inland fresh waters. Practically immune to dezincification.

Arsenical Muntz Metal—Good corrosion resistance to fresh waters. Contains arsenic as a dezincification inhibitor.

Arsenical Copper — Excellent-to-good corrosion resistance to most inland fresh waters.

For more complete information, technical data and the results of corrosion studies, write for 112-page Condenser Tube Manual. For assistance in selecting the most suitable condenser tube alloy, contact our Technical Service Department through your nearest Bridgeport office.

CONDENSER AND HEAT EXCHANGER TUBES

	Duronze IV	Cupro Nickel 70-30	Cuzinal	Arsenical Admiralty	Red Brass	Arsenical Muntz	Arsenical Copper
ANALYSIS							
Copper %	94.25	68.85	77.0	71.0	85.0	62.0	99.6+
Aluminum %	5.5		2.0				
Tin %				1.0			
Zinc %			20.98	27.97	15.0	37.9	
Phosphorus %							0.02
Arsenic %	.25		.02	.03		0.1	0.3
Nickel %		30.60					
Iron %		.40					
Manganese %		.75					
MECHANICAL PROPERTIES							
Ten. Strength psi (Hard*)							40,000
Ten. Strength psi (Soft)	60,000	60,000	60,000	53,000	44,000	56,000	32,000
Yld. Strength psi (@½% extens. under load) (Hard*)							
Yld. Strength psi (@½% extens. under load) (Soft)	22,000	25,000	27,000	22,000	18,000	23,000	
Elongation % in 2" (Hard*)							25
Elongation % in 2" (Soft)	60	45	55	65	45	50	
Rockwell Hardness (Hard*)							B77
Rockwell Hardness (Soft)	F78	F80	F77	F75	F71	F82	
PHYSICAL CONSTANTS							
Melting Pt. (Liq)°F	1940	2260	1780	1720	1880	1660	1981
Density, lbs./cu. in.	.295	.322	.301	.308	.316	.303	.322
Coeff. Therm. Exp. per °F from 77°F to 572°F x10-6	10.0	9.0	10.3	11.3	10.4	11.6	9.5
Thermal Conduct. Btu/sq ft/ft/hr/°F @ 68°F	46	17	58	64	92	71	112
Elec. Cond. % IACS @ 68°F Soft	17.0	4.6	23	25	37	28	45
Mod. of Elas. (Tension) psi.	17,500,000	22,000,000	16,000,000	16,000,000	17,000,000	15,000,000	17,000,000
FABRICATION PROPERTIES							
Machinability Rating**	20	20	30	30	20	40	20
Cold Working	G	G	E	E	E	F	E
Hot Working	G	G	F	F	G	E	E
Hot Working Range °F		1700-1900	1400-1600	1200-1450	1450-1650	1150-1450	1400-1600
SPECIFICATIONS							
A.S.T.M.	B111-Al Bronze	B111-70-30 Cupro-Nickel	B111-Al Brass Type B	B111-Admiralty Type B	B111-Red Brass	B111-Muntz	B111-Arsenical Copper
Federal				WW-T-756			
Navy		44T39A 44T40Int.		44T7 Int.			
Army							
AMS							

* Hard temper—values are for temper suitable for condenser installation.

** Machinability rating—free cutting brass=100.

E—Excellent G—Good F—Fair P—Poor

All figures are nominal values and should not be used as specifications.

"Bridgeport" BRASS CO. **BRIDGEPORT BRASS**

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

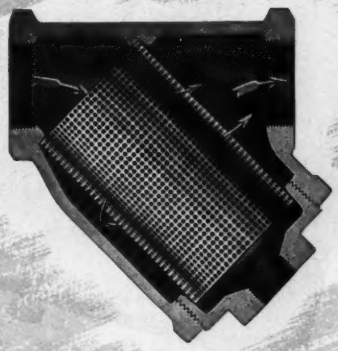
NOW!...POSITIVE PROTECTION from Abrasives

for Instruments, Regulators, Pumps, Traps, Meters, etc.

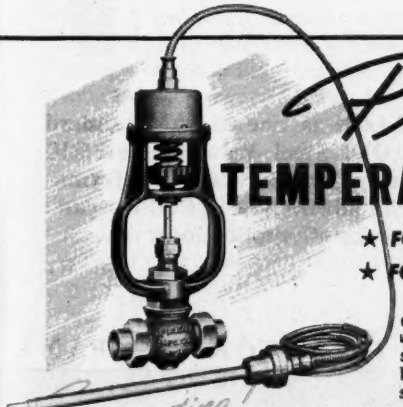
Installed ahead of regulators, pumps, traps, etc., McAlear No. M-530 Strainer positively removes all grit, pipe cuttings and other abrasive materials from pipe lines. It is instantly cleaned by opening of blow-off in flange.

BODY is precision-machined cast iron with screwed ends. Monel metal 20-mesh (400 holes per square inch) is standard. 40-mesh (1600 holes per square inch) available on special order. Working pressures up to 125 p.s.i. Sizes ½" to 2" available for *immediate* delivery.

For informative bulletin, write McAlear Manufacturing Company, Automatic Control Division of Climax Industries, 1915 S. Western Avenue, Chicago 8, Illinois.



McALEAR No. M-530
New High Quality, Low-Cost, Self Cleaning Y-Type Strainer—with Monel Metal Basket



EXTRA SENSITIVE, accurate, easily adjusted new McAlear No. M-3101 (self-powered) Temperature Regulator for steam, water or gas.

Precision TEMPERATURE CONTROL AT LOW COST

★ ***FOR PROCESS INDUSTRIES***
★ ***FOR HEATING APPLICATIONS***

STANDARD temperature range: 140° to 180° F. Sizes: ½ to 2 inches. Construction: Union ends, double port, bronze body, bulb and fittings standard. Spiral wound, brass armored tubing standard length 8 feet. Other sizes available in ranges of 40° each from 70° to 260° F.

This new McAlear No. M-3101 incorporates all the advanced features developed by McAlear in 35 years of building temperature controls for heating and processing.

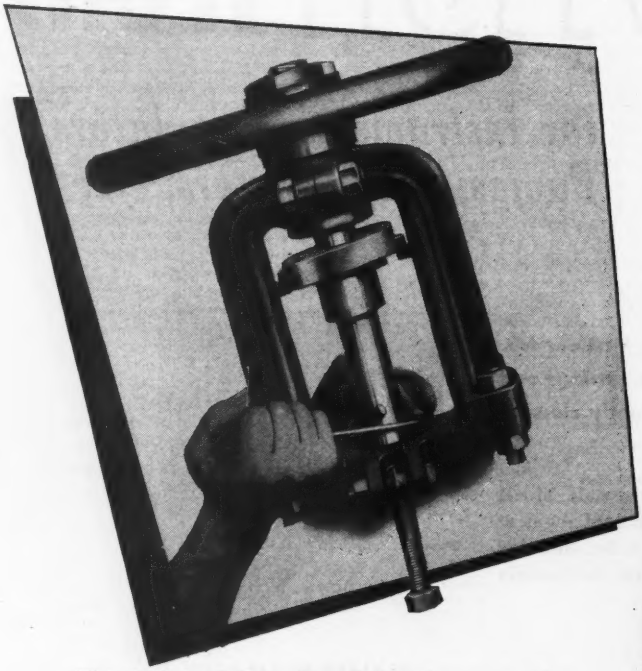
Trim, compact and rugged, it establishes new standards of sensitivity, dependable accuracy and easy adjustment. Write for bulletin.

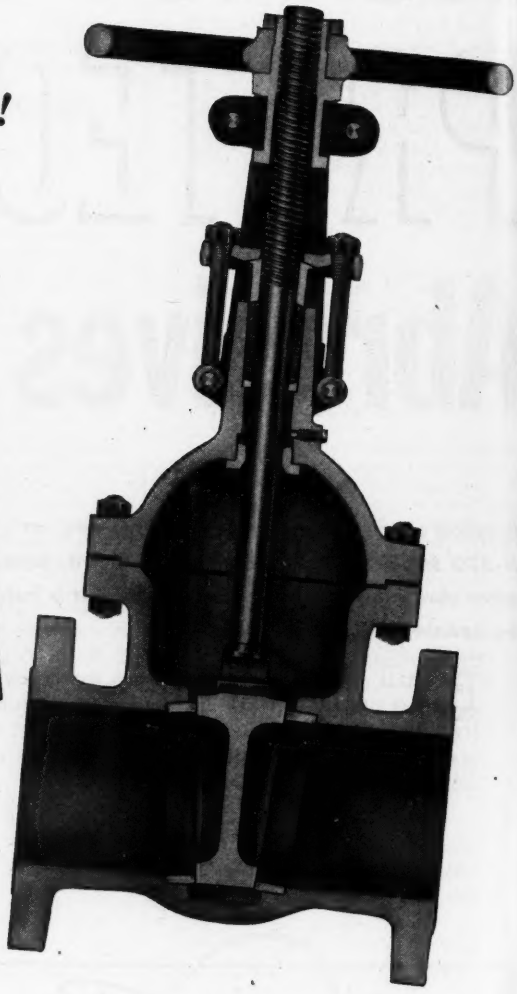
CLIMAX INDUSTRIES

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL—GAS

You don't need 3 hands

to repack this valve!





This OIC Steel Valve has all the advantages of 2-piece gland-and-follower construction PLUS the exclusive LIFT-LOK feature. When repacking is needed the maintenance man lifts gland and follower as a single unit. He turns the gland slightly so that its cam-shaped rim rests on two lugs on the yoke. Then he repacks easily and quickly without fumbling or hindrance.

This is *only one* of many ways we have found to give you more for your money with OIC Valves. Your OIC distributor has the full story.

The LIFT-LOK is one of the standard features of OIC Steel Valves. Your OIC Distributor can give you detailed information on special advantages in OIC Iron and Bronze valves for all applications.

THE OHIO INJECTOR COMPANY

OIC VALVES

WADSWORTH • OHIO

In Gardening It's

A GREEN THUMB

You've heard of the chap with a "green thumb." Everything he plants flourishes. Of course, what he really has is an unusual combination of knowledge, experience, and great enthusiasm for what he's doing.

Call it "green thumb" . . . call it knowledge . . . call it "feeling" for the job . . . it's a quality that every Stephens-Adamson engineer brings to Material Handling problems.

It comes to him from long association with a group of progressive conveyor engineers . . . with a company that for 45 years has led the field with new units and new methods.

This "feeling" for the job is supplemented by a complete line of conveyors and accessories from which S-A engineers can make unrestricted choice—the right equipment . . . to convey the right volume . . . to the right place . . . at the lowest cost per ton over the long term.

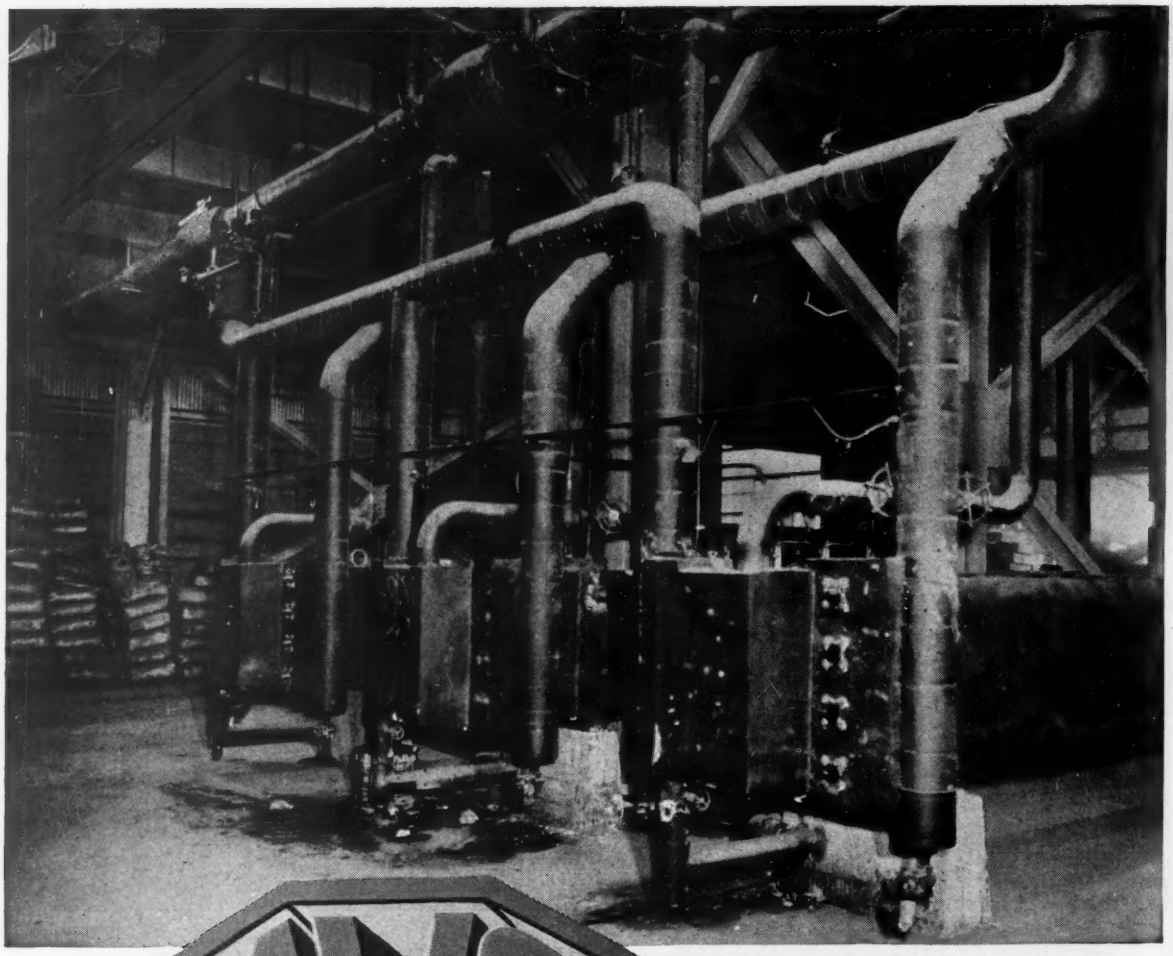
If you want the man with the "green thumb" in the bulk material handling field, talk to an S-A engineer.

STEPHENS-ADAMSON MFG. CO.

51st RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. • BELLEVILLE, ONT.

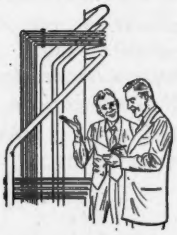
Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



NAVCO

TROUBLE FREE SERVICE



The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of trouble free service.

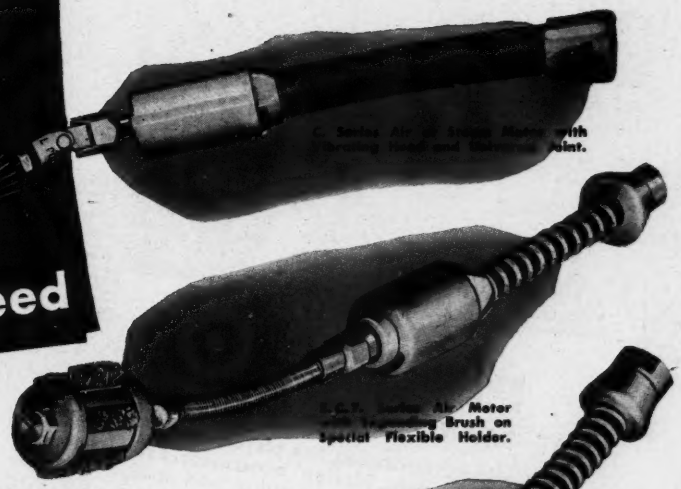
Consult Navco for your next Piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO

There is a WILSON tube cleaner for every power plant need



...and the "check list" tells all about them

No matter *what* the installation — fire or water-tube boilers, condensers, heat exchangers, oil heaters and coolers — there is a WILSON Tube Cleaner specifically designed to solve your tube cleaning problem — with speed that cuts down-time and allows more unit operating time.

Products of years of experience in tube cleaning processes, WILSON tube cleaners embody exclusive design features which make possible such speed and efficiency.

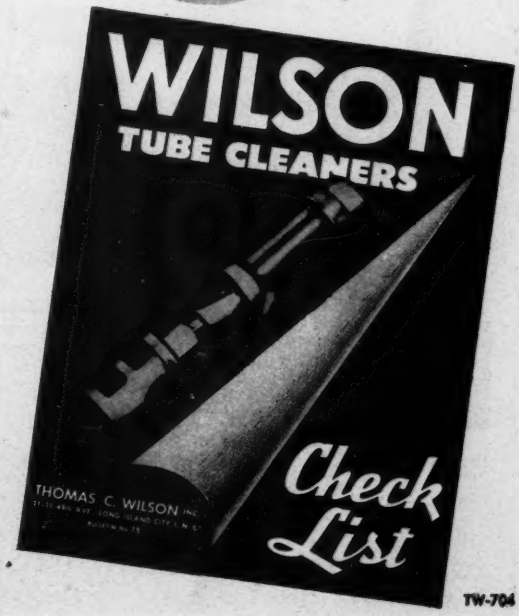
Like thousands of other engineers, you can obtain the same tube cleaner performance through use of the Wilson Tube Cleaner's Check-list (25,000 copies requested already). A glance at the booklet will show you how to determine quickly the correct choice of Wilson tube cleaning equipment (motor, cutter head, flexible shaft, or other accessory), so you will be assured of most efficient tube-cleaner performance.

In addition, this six-page booklet offers valuable hints on tube cleaner operation as well as maintenance "tips" which will insure against costly wear and tear of your tube cleaners — for longer life!

Engineers know that tube cleaning problems have a bad habit of cropping up when they're least expected. But you can be prepared if you have the Wilson Tube Cleaner's Check List within easy reach. So *write today* for your copy. It will prove to be a shrewd move. Please address department N.

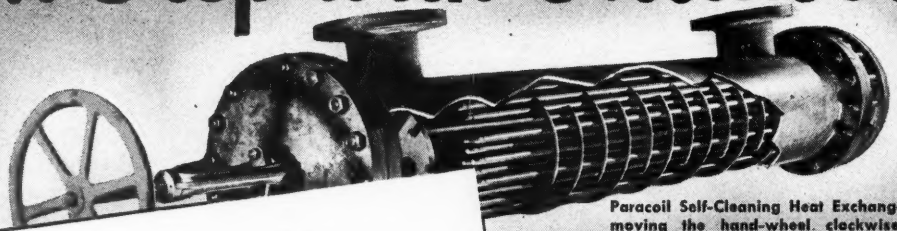
THOMAS C. WILSON, INC.
21-11 44th Avenue, Long Island City 1, N. Y.

WILSON
TUBE CLEANERS



TW-704

In Step with Industry



Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

Paracoil

HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

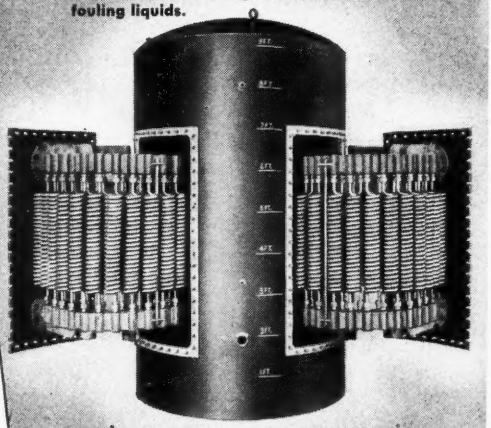
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

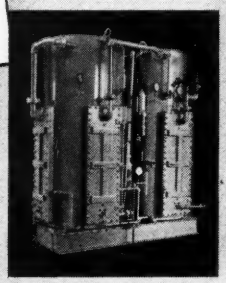
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

To those with fouling problems: Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

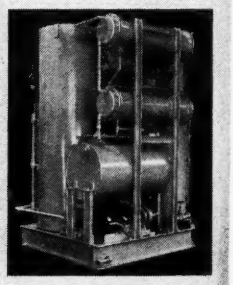


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



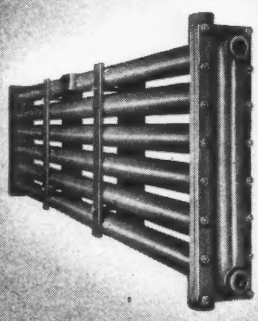
FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

DAVIS ENGINEERING CORPORATION

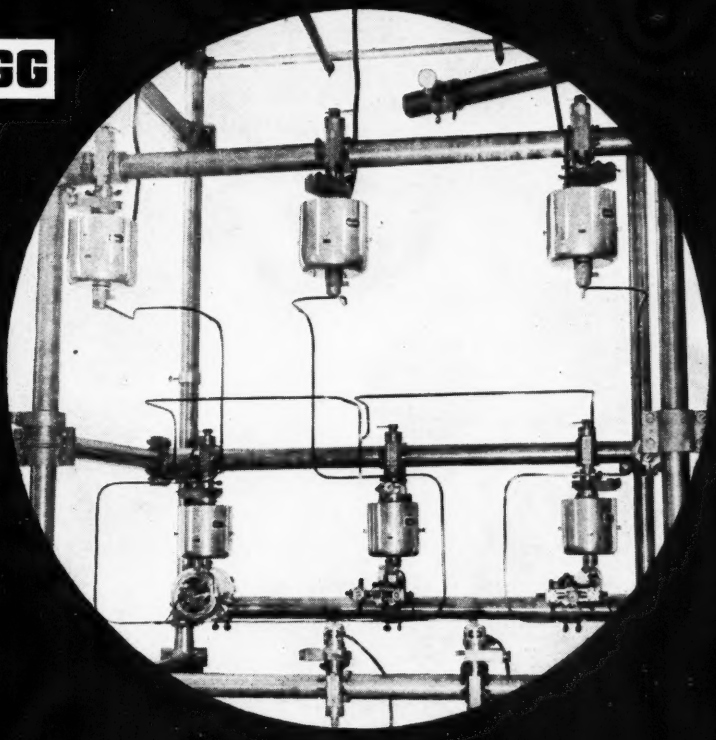
1068 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

KELLOGG MODEL TESTING APPARATUS

set up for determining end reactions and stresses in 1250 psi, 900 F. steam line

M KELLOGG W



THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.

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LOS ANGELES: 609 SOUTH GRAND · HOUSTON 2, TEXAS: 402 ESPERSON BLDG. · TULSA: PHILTOWER BLDG.

For BOILER WATER LEVELS . . .

The Henszey Boiler Feed Regulator provides a low cost method of continuous, automatic and accurate boiler water level control in one simple compact unit. Once installed and set for operation, no further attention is necessary—nothing to get out of order—nothing to rust.

HENSZEY *Boiler Feed* REGULATORS

help avoid the hazards of high, as well as low water levels. They function night and day under all load conditions. If the boiler needs water — the Henszey Regulator delivers just the right amount to maintain proper efficient boiler water levels. Made for pressures up to 600 lbs. and in pipe sizes up to 4 inches.

Send for complete information or contact your nearest Henszey Representative.

HENSZEY COMPANY • Dept. C-4, Watertown, Wis.

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BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Science and the War Effort

(Continued from page 53)

The fact of the German failure, and the fact of the basic causes which produced it, indicate a further conclusion. It is this: If a modern scientific war must be fought, the most effective way in which to fight it is under the temporary rigid controls which a continuing democracy voluntarily imposes upon itself as it girds itself for combat. Such a regime, all other things being equal, can outclass any despotism in bringing to bear on the struggle the combined efforts of science, industry, and military might.

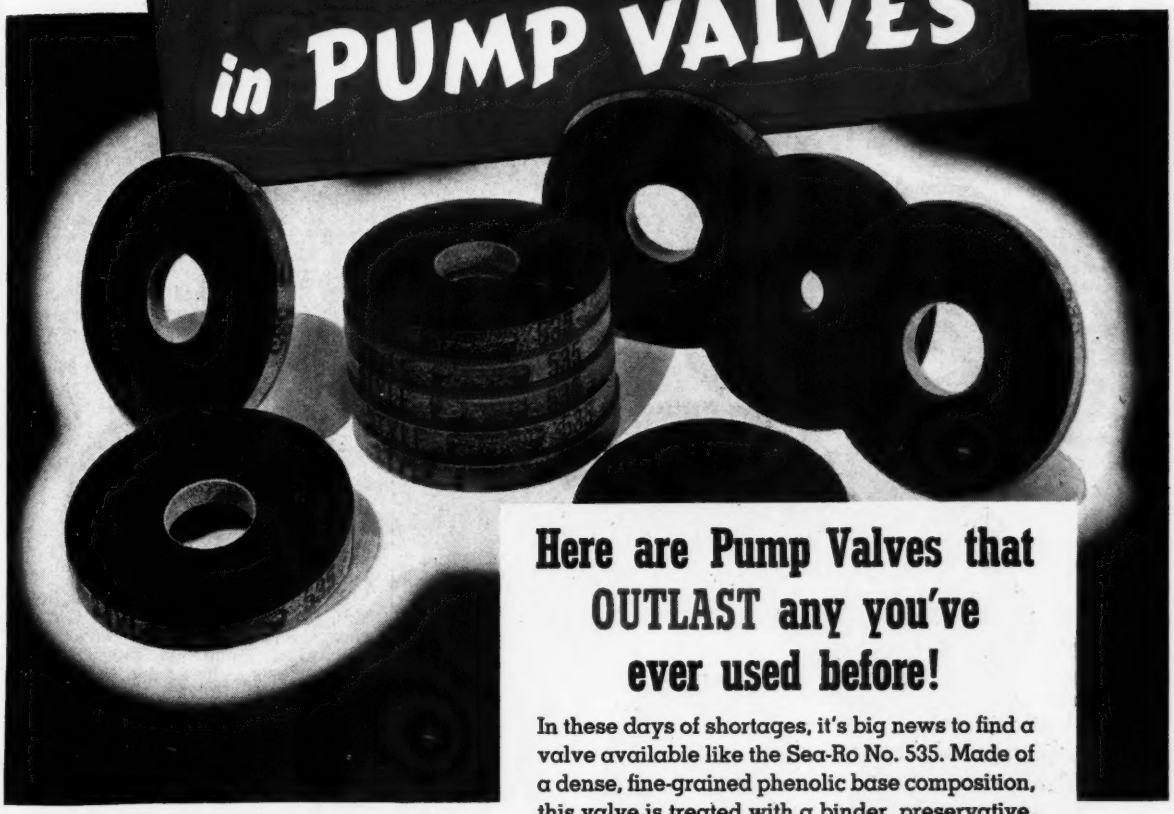
A democracy is efficient in emergency, for the free spirit which it engenders in its normal course is an essential ingredient of great accomplishment under stress. The old contention that only totalitarianism can cope with the complexities of modern life is a fallacy.

This voluntary collaboration of free men is the collaboration of strong parts of a stronger whole. War, with its urgencies, demands that this common effort be exerted in more or less rigid temporary organization. But the free spirit of groups confident in their own freedom and strength, as our experience has clearly shown, accepts these controls willingly and understandingly. It knows that they fortify the union in which there is strength. In times of peace, we can disencumber ourselves of rigid organization. It is important that we do so, particularly in the world of science, where our need for fundamental research will be best met by independent pioneering endeavor unhampered by emergency forms.

Before us and the other nations of the world, we trust, lie peaceful years. If that trust is to be realized, we know, the work to be done is filled with great trials and great demands. To maintain peace calls for devotion and sacrifice equaling if not surpassing what waging war exacts. In the new and more complex world before us, to maintain peace will require collaboration among nations equaling if not surpassing the collaboration among men which we have seen. The great outlines of that collaboration are already taking form.

Here, then, lies the profound significance of the renewed faith in our governmental philosophy which our wartime experience has given us. We have seen written boldly on the record of history that free men, free groups, free institutions, can merge their wills and their energies and by so doing can remain free and strong and can assure freedom and strength to others. That same spirit of mutual support in shared strength will sustain our hands in the great tasks ahead. What the several callings and professions within our nation can do and have done, the nation itself can do—and must!

The Biggest News in PUMP VALVES



Here are Pump Valves that OUTLAST any you've ever used before!

In these days of shortages, it's big news to find a valve available like the Sea-Ro No. 535. Made of a dense, fine-grained phenolic base composition, this valve is treated with a binder, preservative, impregnated with graphite, and then laminated under pressure of 2000 lbs. per square inch.

The Sea-Ro No. 535 valve will outlast any other you've ever known because:

1. It resists absorption and minimizes swelling.
2. It is non-warping.
3. It has proved more efficient than metal type valves.
4. It has a velvety smooth surface, which can be re-surfaced when worn, to be used again and again.

Limited Stock Just Released!

SEA-RO
Marine & Industrial Pump
VALVES

SEA-RO

FREE SAMPLE: Send for free sample valve. Test and report performance in your own shop under your own operating conditions. No obligation. Simply write on your business letterhead to: Dept. A

Sea-Ro Packing Company • Wood Ridge, N. J.

IF IT HAS 2 BRONZE SEATS GROUND TO A TRUE BALL JOINT

It's Definitely a Dart

This feature distinguishes a Dart Union from all others—it has two bronze seats ground to a true ball joint. That means it will close easily to a leakproof connection, and open as easily if you have use for it elsewhere.

And it's hard to damage a Dart, for body and nut are made of high-test, air-refined malleable iron.

In length of service, Darts cost least. Ask your supplier.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE 5, R. I.

Obituaries

Albert L. Scott

ALBERT L. SCOTT, president of Lockwood Greene Engineers, Inc., died March 2 of a heart ailment in his home at Chappaqua, N. Y., at the age of 67.

Mr. Scott was born in Cleveland. He studied at Brown University and began his engineering work with Lockwood Greene in 1900, holding various executive positions until he became president in 1926. During the first World War he served as a member of the committee on supply, Council of National Defense, equipment division, Army Quartermaster Corps, in 1918.

Mr. Scott achieved especial prominence in 1932, when the Laymen's Foreign Missions Inquiry report was released after two years' work by a group of which he was chairman.

Mr. Scott was a trustee of Chicago University, Brown University and Spelman College. Until recently he was president of the board of trustees of Riverside Church and a member of the American Historical Society, Delta Upsilon fraternity and the University Club. He was a former president of Rockefeller Center, Inc.

He is survived by his wife, Mrs. Alice Chamberlin Scott; a daughter, Mrs. Robert Dods of Newton Center, Mass., and four sons, David and Richard of Chappaqua, Albert L., Jr., of Martha's Vineyard, Mass., and Lieut. Comdr. Robert, USNR.

J. Howard Courtner

J. HOWARD COURTNER, age 40, assistant general manager of Dowell Incorporated at Tulsa, died February 27 of a stroke in a Chicago hospital.

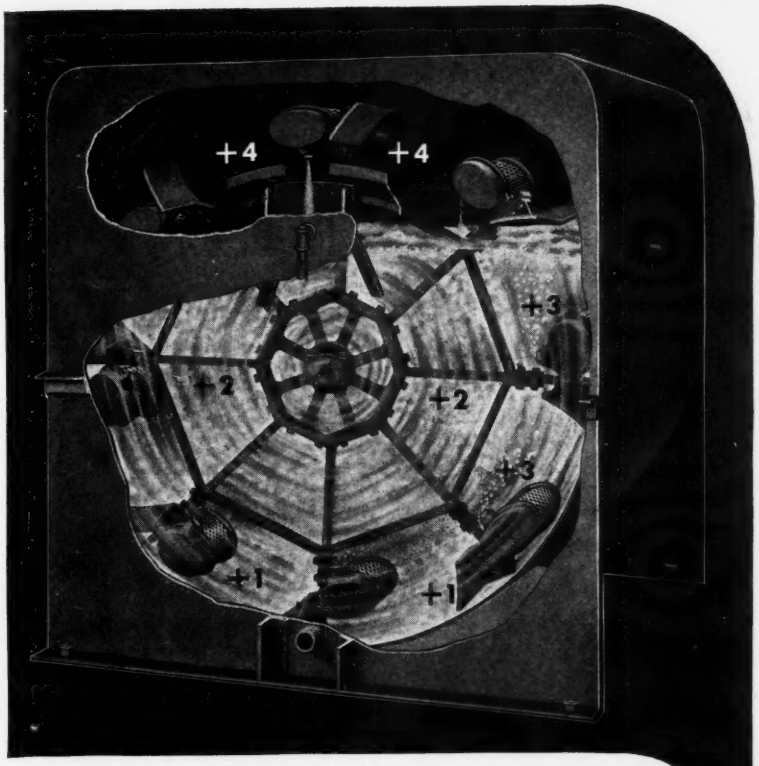
Mr. Courtner, born in Oklahoma City, was educated in Oklahoma schools, where he attended both Oklahoma City University and the University of Oklahoma. He has been in the employ of Dowell Inc. since August, 1934. He advanced with the organization from treating engineer to station manager at Hobbs, New Mexico and, in April, 1939 to district manager of the Salem, Illinois, territory. In January, 1945, Mr. Courtner was transferred to the general office of the company located in Tulsa where he held the position of assistant general manager.

Mr. Courtner is survived by his wife, Betty, a daughter, Connie, and a son, Charles, all of Tulsa; his father and mother, Mr. and Mrs. Wm. H. Courtner of Oklahoma City, and a brother, William, of Wilmington, Del.

Leonard H. Davis

LEONARD H. DAVIS, consulting engineer of Union Carbide and Carbon Corp., died at his home in New York City, February 19, after a short illness. He was 73 years of age.

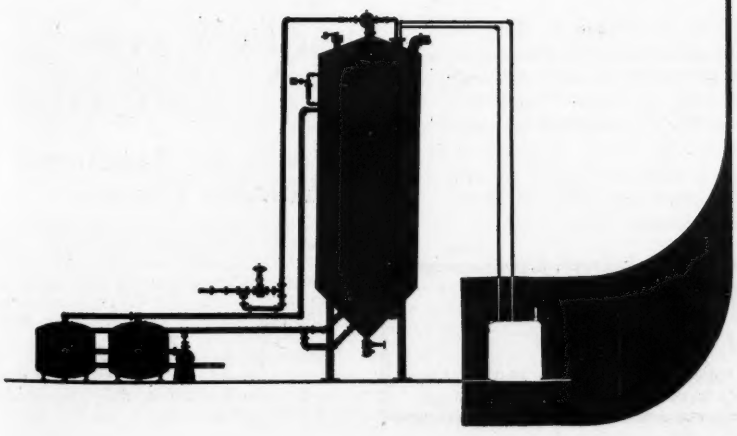
Mr. Davis was born at North Chelmsford, Mass., in 1872, received his early education in Lowell, Mass.,

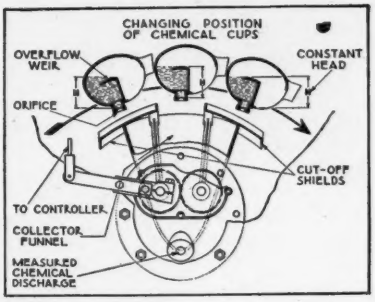


INFILCO CHEMICAL MIXER AND FEEDER

HOT-FLOW SOFTENERS

CONVERT WATER INTO BOILER FEED





A constant head over a constant orifice in any discharge position.

INFILCO Chemical Mixers and Feeders contribute greatly to the enviably successful operation of Hot-Flow Softeners.

Their function is to hold a chemical solution, or mixture, at a uniform strength—and, to feed it accurately.

They are doing just that—year after year—because of the cumulative effects of these plus value design features—

+1 The half-rounded bottom—with plow-shaped agitators sweeping close—eliminates dead spaces where any solids can deposit.

+2 Agitators—revolving vertically—circulate the mixture in a positive up and down motion. Stratification is impossible.

+3 As the cup moves down, trapped air escaping from its discharge orifice, blows out obstructions—keeping the orifice clean.

+4 Every chemical cup is designed to maintain a constant head over the orifice during the entire period of discharge.

And the cumulative results are—

+1 + +2 = ***Uniform Solution or Mixture.*** Samples, taken at random from the Mixer and Feeder, will never vary in chemical content more than 1½%.

+3 + +4 = ***Accurate Feeding.*** A constant head over a constant sized orifice is a precise means for feeding an unvarying volume of solution.

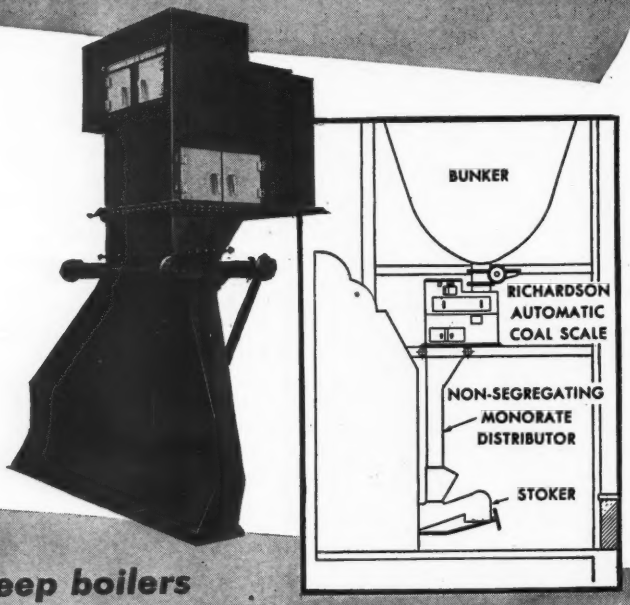
Not only the Infilco Mixer and Feeder, but also every other component part of the Hot-Flow Softener, has plus value features—every one of which contributes to smoother and more efficient operation. That's why Hot-Flow softening for boiler feed is hot process softening plus.

INFILCO

INFILCO
INCORPORATED
325 WEST 25TH PLACE, CHICAGO 16, ILL.

When Coal is Scarce . . .

GET THE MOST FROM EVERY POUND



keep boilers "on test" with a

RICHARDSON COAL-WEIGHING SYSTEM

Unless you *know* you are getting every B.t.u. and kw.-hr. of which each boiler is capable, one or more of them may be raising your power costs.

But you *can* know—precisely—the performance of every boiler in your plant . . . with a Richardson Coal-Weighing, Conveying and Feeding System. It spots possible losses for you right at the source. The Richardson System weighs and *records* every pound of coal burned —per hour, day, week or year. Evaporation rates, and similar factors, become a definitely known fact.

And, besides pointing out "slacker" boilers, the Richardson System helps you get more efficiency from all of them—for the MONORATE Non-Segregating Spreader assures even distribution of coal across the stoker hopper without separating coarse and fine coal. More uniform combustion is the result.

The complete Richardson System includes, in addition to scale and stoker spreader (or down-take chute to pulverizer), gates from bunker, and flexible inlet. It's a *complete* bunker-to-boiler weighing and feeding system—adaptable to plants both large and small because there are stationary and portable models to fit every requirement in plant layout, space and capacity.

Quite likely Bulletin 1143 will prove that a Richardson System can save you coal; help you meet post-war competition with lower-cost steam. It's worth looking into. Write for your copy today.

D554

RICHARDSON SCALE CO.

CLIFTON, N. J.

Atlanta • Boston • Chicago • Omaha • Montreal • New York • Philadelphia
Minneapolis • Detroit • San Francisco • Toronto • Wichita • Pittsburgh

and was graduated from Harvard University with the degrees of Bachelor of Arts and Master of Arts in 1892.

In 1894, Mr. Davis became civil engineer with the Boston Transit Commission during the construction of the Boston subway, and later was employed as engineer by the Boston Elevated Railroad. From 1901 until 1912 he was associated with the Lake Superior Power Co. and the Tagona Water and Light Co., at Sault Ste. Marie, Ontario, Canada, as chief engineer, and later as general manager of both concerns. In 1903, he also became manager and chief engineer of the Michigan Lake Superior Power Co., located at Sault Ste. Marie, Michigan. This company subsequently became the Michigan Northern Power Co., a subsidiary of Union Carbide and Carbon Corp. In 1926, Mr. Davis was elected a vice-president and a director, and in 1929, president of the Michigan Northern Power Co.

Mr. Davis is survived by his wife the former Josephine Maud Simpson, whom he married at Sault Ste. Marie, Ontario, in 1905, two daughters, Mrs. Reginald W. Pressprich, Jr., and Mrs. Carleton G. Young, a sister, Miss Grace E. Davis of Wellesley, Mass., and six grandchildren.

Joseph B. Crane

JOSEPH B. CRANE, export manager of Combustion Engineering Co., died suddenly of a heart attack at his home in Bridgewater, Conn., on March 9, at the age of 66.

Born in Waterbury, Conn., and graduated from Trinity College in 1902, Mr. Crane joined the test department of General Electric Co., later becoming assistant superintendent of that department. From 1907 to 1915 he was commercial manager of the Great Northern Power Co. at Duluth. For the next three years he was with the American & Foreign Power Co. engaged in investigations and reports on South American properties. He then became vice-president of the Lehigh Power Co. and early in 1921 joined the Ladd Boiler Co. When the latter company was acquired by Combustion Engineering Co. in 1925, he became Pittsburgh district manager which position he held until 1937 when he was made manager of the export department.

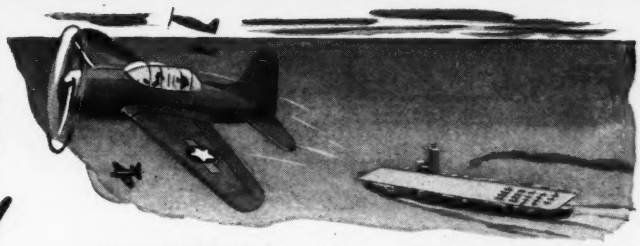
Surviving are his wife, Isabelle F. Crane, two sons and two sisters.

NEWS *from* THE FIELD

Prizes for Resistance Welding Papers

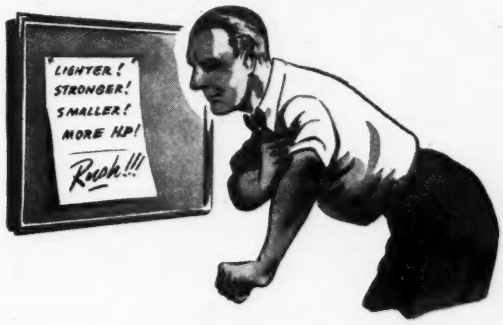
THE RESISTANCE WELDER MANUFACTURERS' ASSOCIATION which has offices in the Citizens Building, 850 Euclid Avenue, Cleveland 14, Ohio, has announced a contest for the most outstanding papers dealing with resistance welding subjects, with cash prizes to be awarded in 1946. The total amount of the awards is $2000 and the wide choice in subject matter is allowed in order to secure eligibil-

Getting Navy Planes into Air Fast was Job for "Super" Motors!



"What We Want" said Navy, "are ½-hour rated elevator motors that'll lift planes from carrier hangar decks, up at 42 ft, down at 52 ft a minute. And they must be exceptionally dependable—under all conditions—because these planes have to be in the air when we need 'em!"

"Look, Here's What We're Using Now. Two standard winch motors on each elevator . . . doing a good job too. But we want something better. Because *two* motors mean extra space, weight and repairs — things we've got to cut down for more important ordnance."



Whew! High elevator speed, low motor speed . . . stronger . . . lighter . . . smaller — this'll take 6 months to design! Then we rolled up our sleeves, tackled first the problem of developing extremely high torque for fast starting under load — solved it with a special field.

How To Get Light Weight — yet maintain the generous motor design for which we are famous — presented still another problem. This one we solved by skilful substitution of copper for steel . . . of war-proved fabrication for casting. Yes, we cut down weight *and* maintained ample, generous design!

Came the Big Surprise! After we put on finishing touches — special corrosion-resistant marine parts, new kind of insulation — we added up design time . . . just one month! And much-needed motors were rolling off the lines less than 4½ months later.

A 1998

Significance: The creative engineering that goes into solving *special* motor problems, like this one, also points out new ways to build better *standard* motors for you! Watch for these new and better motors from A-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

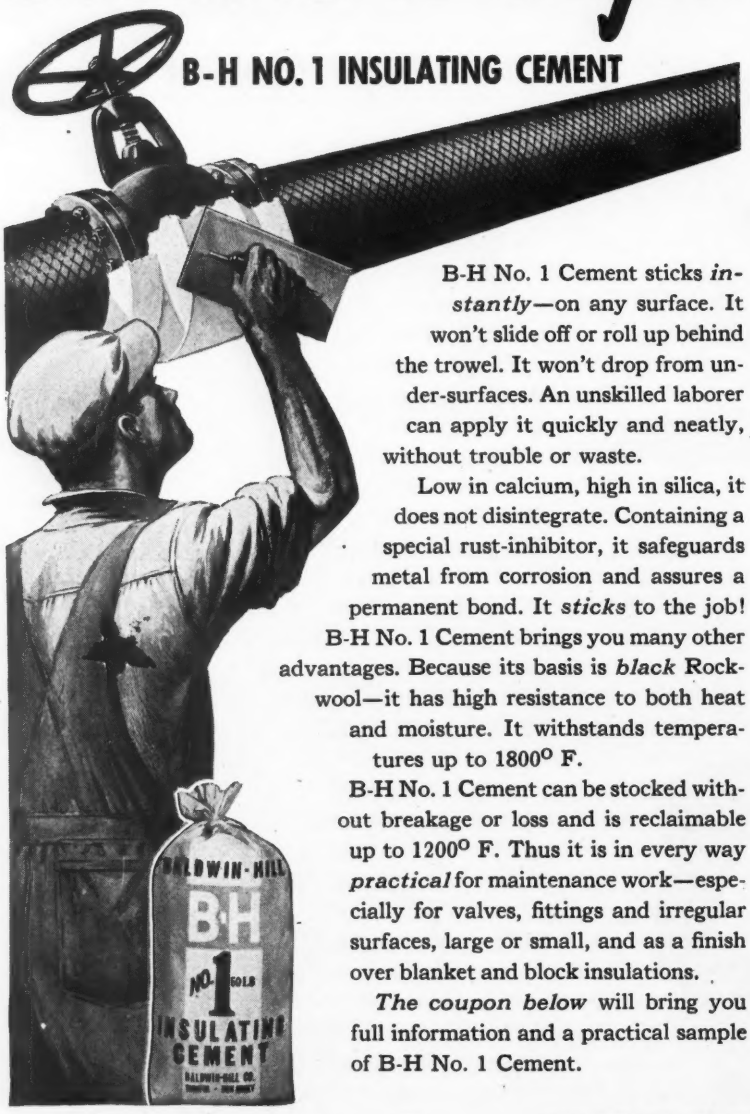
Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

STICKS to the job

B-H NO. 1 INSULATING CEMENT



B-H No. 1 Cement sticks *instantly*—on any surface. It won't slide off or roll up behind the trowel. It won't drop from under-surfaces. An unskilled laborer can apply it quickly and neatly, without trouble or waste.

Low in calcium, high in silica, it does not disintegrate. Containing a special rust-inhibitor, it safeguards metal from corrosion and assures a permanent bond. It *sticks* to the job! B-H No. 1 Cement brings you many other advantages. Because its basis is *black* Rockwool—it has high resistance to both heat and moisture. It withstands temperatures up to 1800° F.

B-H No. 1 Cement can be stocked without breakage or loss and is reclaimable up to 1200° F. Thus it is in every way *practical* for maintenance work—especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

The coupon below will bring you full information and a practical sample of B-H No. 1 Cement.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 569 Klagg Ave., Trenton 2, N. J.
Send information on products checked below:

- ☐ Free sample of B-H No. 1 Cement
- ☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)
- ☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
- ☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

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ity to all papers which cover worthwhile and significant achievements in the field. Judges will be chosen by the American Welding Society, and awards will be made at the 1946 Fall meeting of that Society.

The first prize will be for $750 for the best paper emanating from an industrial source, consulting engineer, private or government laboratory, or the like, the subject matter of which is concerned specifically with resistance welding. A prize of $500 for the second best paper in the above classification and a prize of $250 for the third best in this same classification.

A prize of $300 will be awarded for the best paper emanating from a university source and $200 for the second best paper in this classification. It is stated that the contest is open to anyone, without restriction, from the United States, its possessions and Canada, and the papers entered in this contest should be sent to the American Welding Society, 33 West 39th Street, New York 18, N. Y. Papers must be submitted before July 31, '46.

George R. Wadleigh Enters Consulting Field

GEORGE R. WADLEIGH announces that he is entering the consulting engineering field relating to the pulp and paper industry. Having reached the retirement age under the excellent plan recently set up by the West Virginia Pulp & Paper Co., Mr. Wadleigh severed his connection there as of October 1, 1945.

Mr. Wadleigh is a graduate of Massachusetts Institute of Technology in Mechanical Engineering. For ten years he was associated with Bemis Brothers Bag Co. of Boston and St. Louis, and for 24 years with West Virginia Pulp & Paper Co. All of the engineering work, involving process, steam and hydro-electric plants was under Mr. Wadleigh's direction. He also supervised the power operation and distribution and the development of adequate water supplies.

Mr. Wadleigh has now become associated, under his own name, with Frederic C. Clark, pulp and paper mill consultant, at 7 Dey Street, New York City.

Connell Chosen Technical Director of SMA

THE POST OF technical director has recently been created by the Stoker Manufacturers' Association which is a national trade organization representing the mechanical stoker manufacturing industry. To fill this new post, Lloyd L. Connell of Richmond, Ind., has been selected and will handle and supervise the technical and engineering projects and problems of the Association and those involving the stoker industry as a whole working under the direction of the Association's Engineering and Research Committee headed by A. O. Dady of Bradley, Ill.

Mr. Connell comes to the stoker organization with a rich background of experience both in and out of the stoker industry, having served as national service manager of the Schwitzer-Cummins Co., of Indianapolis, Ind., but most recently was with the

Pumping Facts for Your Fact-finding Board

If moving hydrocarbons is your problem ask about

WARREN PUMPS

These pumps are efficiently handling Rich Oil, Lean Oil, Isobutane Reflux, Isopentane Reflux, Debutanizer Reflux, Finished Product.

Other Warren Pumps are used for Steam Condenser Circulating, Cooling Tower Water, Compressor Jacket Water . . . and among the facts definitely proven by experience is that dependability and longer life, plus minimum maintenance, is the type of round-the-clock performance consistently turned in by Warren Pumps at this modern plant.

Countless other fact-finding reports tell the same story and are conclusive evidence of what you can reasonably expect from all types of Warren installations.

Inquiries solicited.

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

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Indianapolis Los Angeles Minneapolis New Orleans New York
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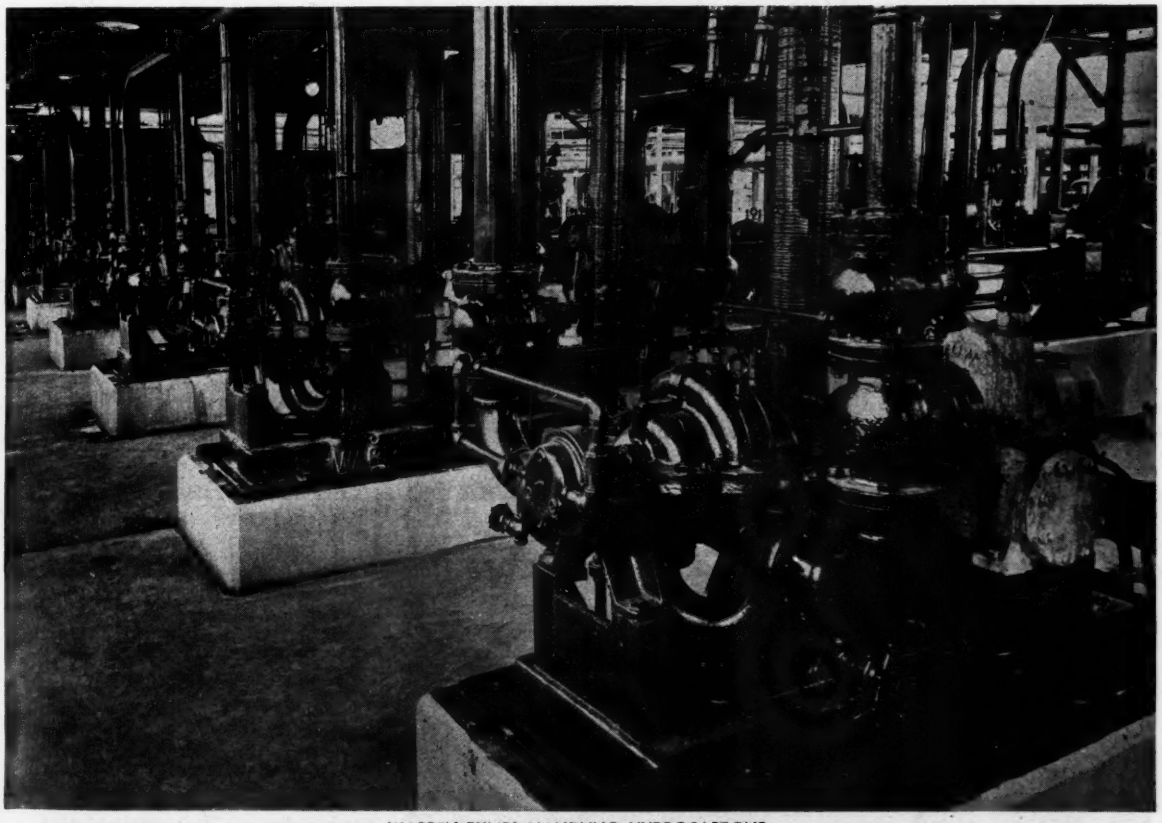
P-3



WARREN PUMPS HANDLING HYDROCARBONS

WARREN PUMPS

YOU CAN'T POUR LOST SYRUP ON A PANCAKE!

Between the tree and the table there are many places where syrup is lost . . . leaky valves and pumps for instance. The losses of liquids or gases escaping past improper packing is enough...but the *lost production* due to needless shut-downs for the replacement of faulty packing is downright costly! That's why particular care should be exercised in the selection of the *right* packing for every application.

USE THE *RIGHT* PACKING!

PALMETTO makes the *right* packing for every one of your applications . . . the right quality for most economical maintenance . . . the right design for most effective sealing—with least wear to rods, shafts and stems.

Write today for bulletins which show *what* packings to use *where*.

GREENE, TWEED & CO.
Bronx Blvd. at 238th St., New York 66, N. Y.
Plants at New York, N. Y. and North Wales, Pa.

GT-1528

PALMETTO PALMETTO for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPER-CUTNO (blue asbestos) for acids. KLERO for foods.

Self-Lubricating **PACKINGS**

United States Army Air Forces having advanced to the rank of Lieutenant Colonel at the time of his discharge. He served in the Middle East theatre of war with the Ninth Air Force in Syria, Egypt and Libya and in the Mediterranean sector in Tunisia and Italy with the Fifteenth Air Force.

Coal Analysis Bulletin

TYPICAL ANALYSIS and other information about bituminous coal produced in the Western Kentucky, District 9 area, have been incorporated in a new publication issued by the U. S. Bureau of Mines. The bulletin is intended as a purchasing guide for coal buyers in the District 9 region. The publication contains descriptive tables of rail and river shipping mines, maps showing their locations, and analytical tables of seams by mines and counties. The data given will help purchasers to compare quality of coal shipments and also will assist in the selection of special purpose fuels. The Bureau indicates that this is the sixth of a series of consumers' guides formerly prepared by the Office of the Bituminous Coal Consumers' Counsel in colaboration with the Bureau of Mines. The publication is entitled, "Typical Analysis Bituminous Coals, District 9," and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 20 cents a copy.

New Officers for NAFM

AT THE TWENTY-NINTH ANNUAL MEETING of the National Association of Fan Manufacturers held at Hot Springs, Virginia, January 24-25, 1946, the following officers were elected for the ensuing year: G. C. Derry, president; R. H. Nelson, vice-president; and L. O. Monroe, secretary-treasurer.

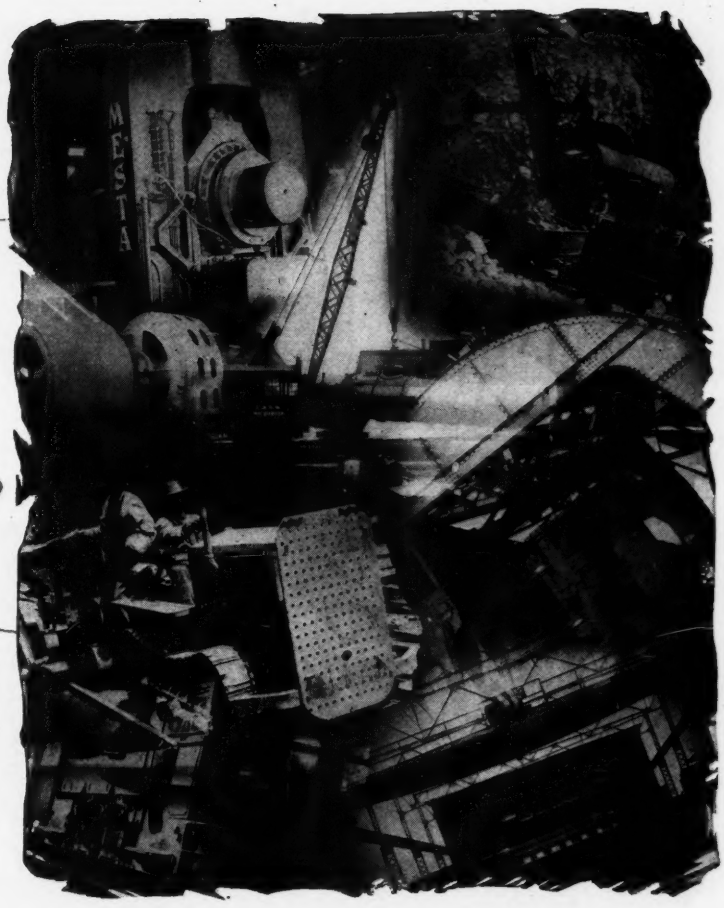
Mr. Derry is vice-president and general manager of the B. F. Sturtevant Company, Boston, Massachusetts and Mr. Nelson is president of The Herman Nelson Corporation, Moline, Illinois.

German Asbestos Industry

ROBERT CRYOR, general manager of the Cicero plant of the Union Asbestos and Rubber Co., recently made an investigation of the wartime operation of the German Asbestos Textile industry, as a representative of the Technical Industrial Intelligence Committee of the Joint Chiefs of Staff.

The purpose of this investigation was to determine what technological progress Germany had made during the war in the processing of asbestos textiles that would be of interest and value to the asbestos industry in the United States. Mr. Cryor reports that at present this industry is operating at about 25 per cent of the remaining plant capacity. He also reports that the German industry was and is far behind the United States Asbestos Textile Industry. Only in the field of substitute materials has Germany shown any progress not duplicated in the United States.

"No bearing troubles..



...with Tycol E.P. Lubricants"

"Not a bearing overheated . . .
Service-life doubled . . .
Races undamaged . . .
Better performance . . .
Maintenance costs cut . . ."

— were the statements made recently by a lubricating engineer. "Yet," he went on, "the anti-friction bearings in our plant operate continuously under severe heat and moisture conditions — tremendous loads."

This is one of the many uses of Tycol E. P. Lubricants. For more information call, write, or wire your nearest Tide Water Associated Office.

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FOR COMPLETELY AUTOMATIC AND DEPENDABLE VOLTAGE REGULATION

Burlington Synchrostat
(REG U.S. PAT. OFF.)
VOLTAGE REGULATOR

The Burlington Synchrostat, Type SR, Model SF, has proven to be the answer to the problem of voltage regulation in numerous installations. Its inherent sensitivity in following voltage changes makes it respond quickly and accurately in restoring generator voltage to normal.

SPECIAL FEATURES ARE:

Simplified control . . . rugged construction . . . simple installation . . . minimum maintenance . . . unaffected by reasonable vibration . . . automatic polarity reversal . . . rapid, positive response to maintain normal voltage.

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PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

MANUFACTURERS' News

Supercharged Diesel Engine

THE BUCKEYE MACHINE CO. of Lima, Ohio, has now under construction a new seven-cylinder, supercharged Diesel engine, which is being built at its factory in Lima. This new line of engines of which 26 are scheduled for delivery to the United Nations Relief and Rehabilitation Administration is being built to provide power plants for utilities in war-devastated areas throughout the world.

The engine is 28 ft long, 7 ft wide and 9 ft high and develops 633 hp at 600 rpm, delivery 400 kw of electrical power. The unit is complete with supercharger, generator, switchboard, starting tank and alarm system, which protects the engine from damage due to failure of cooling water or lubricating oil.

New Plant for American Steel and Wire

ANNOUNCEMENT HAS recently been made by the American Steel and Wire company, the U. S. Steel subsidiary, that more than $1,000,000 will be spent to modernize and increase production of stainless steel wire at the Waukegan, Illinois, Works. These improvements will be started immediately and place the Waukegan plant among major stainless steel round wire producers in the country.

Facilities of the most modern type will be housed in a new industrial building providing 100,000 sq ft of floor space. The project includes facilities for a completely integrated unit, drawing and processing, from hot rolled rod to the finished product. Wire ranging from ½-in. to 0.004 in. in diameter in rounds and shapes will be produced in the new unit. Provisions also will be made for rod storage, heat treating, cleaning, wire drawing and finishing operations, such as grinding, polishing, straightening and cutting, spooling and packaging.

Changes in Westinghouse Personnel

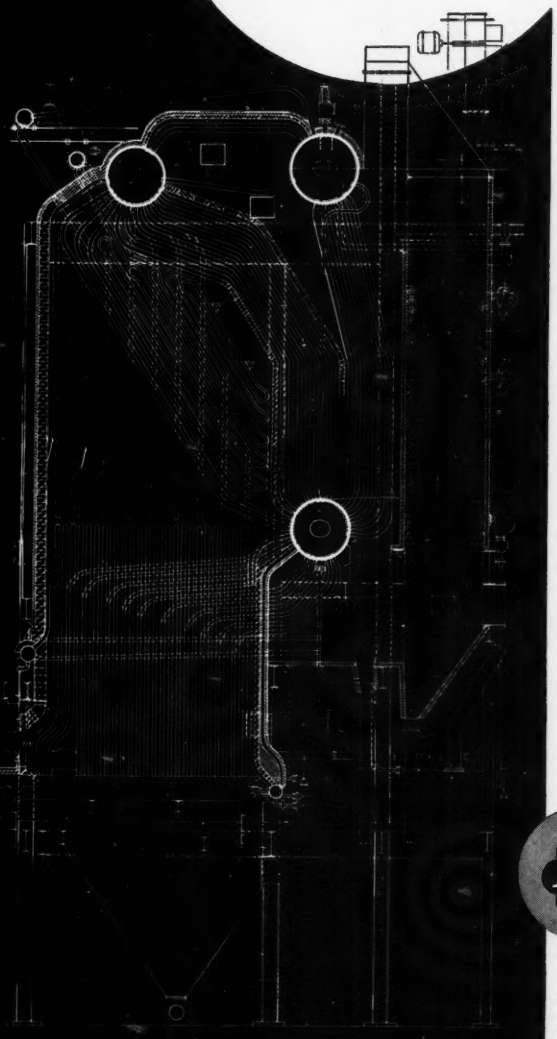
DURING THE past month the Westinghouse Electric Corp. has made the following announcements of changes in its personnel:

Gwilym A. Price has been elected president to succeed George H. Bucher, who has resigned from that office. A. W. Robertson, who as chairman, has been the corporation's chief executive officer since 1929, has reached retirement age and was elected chairman of the Westinghouse Board of Directors.

Frank D. Newbury has been elected a member of the company's Board of Directors. William B. Meek has been chosen general manager of the Westinghouse Electric Supply Co. and his position as manager of the company's Midwest District has been assumed by Robert P. Smith with headquarters in St. Louis.

Edge Moor

standard 3-drum **Bent Tube Boiler**



Typical of all Edge Moor design, the standard 3-drum unit has a record of sustained high operating efficiency for many industries and over periods of many years. This type provides generous water storage with positive circulation at all ratings; it is adaptable to all pressures, capacities, methods of firing and total temperature requirements. Steam drums are equipped with efficient steam dryers or washers as may be required.

The Edge Moor Standard 3-Drum Boiler has its widest application in moderate to large size units where high ratings and continuous service are demanded. With suitable furnace arrangements, it is adaptable to all fuels. EDGE MOOR IRON WORKS, INC., Main Office and Works, Edge Moor, Del. Branch Offices: New York 1, N. Y., Empire State Building; Chicago 2, Ill., One No. La Salle St.

Edge Moor 3-Drum unit equipped with continuous discharge spreader stoker and horizontal bare tube superheater. Capacity, 100,000 lbs. steam per hour at 750 lbs. pressure and 825° F. total steam temperature.

EDGE MOOR

Steam Generating Equipment

TESTED for ACCURACY

All tubing from which Pyrex and Corning Gauge Glasses are made is drawn on specially designed machines which draw the tubing to uniform accuracy. That is why breakage due to installation strains is substantially eliminated—why these gauge glasses are easy to install.

Pyrex and Corning Gauge Glasses are made of glasses that are chosen with recognition of actual working conditions. They will give excellent service when used at pressures for which they are recommended. Remarkable resistance to the solvent action of steam and hot water and a hard smooth surface that resists scratching and abrasion are other factors which mean long life, economy and trouble-free performance.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses BRAND

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

A. L. Atherton has been appointed advisory engineer and Fred C. Heyl manager of the Quality Control department of the East Springfield, Mass., plant. D. J. Mosshart has been appointed engineering manager of the Stoker Department of Westinghouse Electric Corporation's Steam Division at Philadelphia, Pa.

J. F. Mann, formerly assistant manager of the Industrial Apparatus department of the company in New York City, has been appointed manager of the new Service Department. Douglass B. Williams becomes manager of the East Central District of the Westinghouse Electric Supply Co. with headquarters in Pittsburgh, Pa.

Robert P. Smith is now manager of the Midwest District of the Westinghouse Electric Supply Co. with headquarters in St. Louis, Mo. Ralph E. Lovdal is now manager of the Northern District of the company with headquarters in Milwaukee, Wis. Clarence G. Ward has become manager of the Peoria, Ill., branch of the Supply Co.

International Nickel St. Louis Section

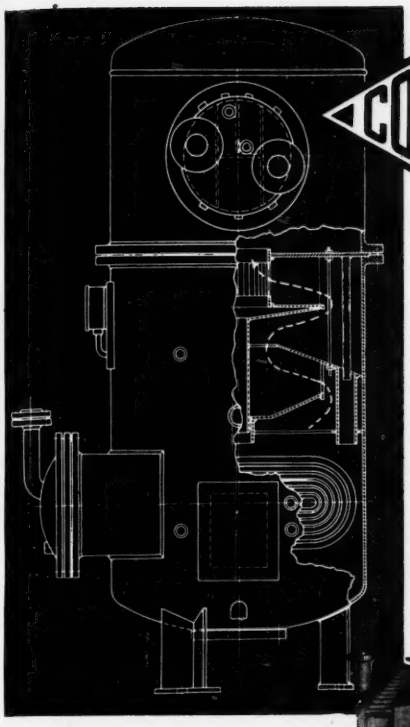
THE ST. LOUIS TECHNICAL SECTION of its Development and Research Division has recently been announced by the International Nickel Co. to serve the state of Missouri, southern half of Illinois, southwestern section of Iowa, northern half of Arkansas, western portion of Tennessee and States of Nebraska and Kansas. This section will be under the direction of George A. Fisher, Jr., who will furnish technical assistance in the territories mentioned. Offices are located in the Ambassador Building, 411 N. Seventh St., St. Louis 1, Mo. This is the third new technical section which has been opened by The International Nickel Co. in recent months. One was opened in Cincinnati on December 1, and another in Minneapolis on January 15, the St. Louis section being opened on February 15.

Advances in National Aluminate

NATIONAL ALUMINATE CORP. of Chicago, Ill., has recently announced the following appointments to positions in its research and sales departments: John W. Ryznar becomes Director of Research and will be in charge of all research pertaining to both the railway and industrial divisions and will head the Bacteriological Department of the Industrial Division of National Aluminate Corp. Mr. Ryznar received the degree of Ph.D. from the Ohio State University in 1936 and shortly afterwards joined the corporation.

Arthur L. Jacoby has been named assistant Director of Research of the corporation and has been associated with this company since 1938 as chief organic chemist, coming to National Aluminate Corp. from Iowa State College, Department of Chemistry. He also carries the degree of Ph.D. conferred upon him in 1938 by the Iowa State College at Ames, Iowa.

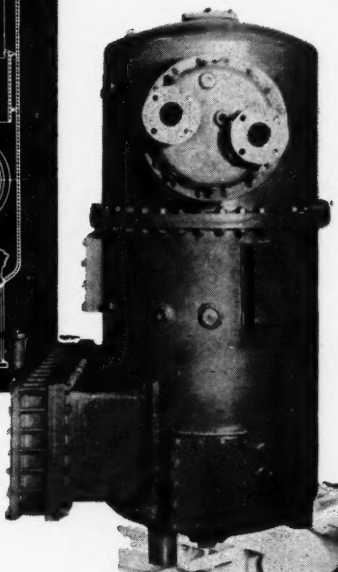
Raymond Reuter has joined the staff of the Chicago Chemical Co. which is a subsidiary of the National Aluminate Corp., as sales and technical representative. This company manufactures cracking catalysts for the petroleum industry.



CONSECO

Low Pressure EVAPORATORS

offer you these advantages



1 They use low pressure steam, utilizing heat from auxiliary equipment otherwise wasted.

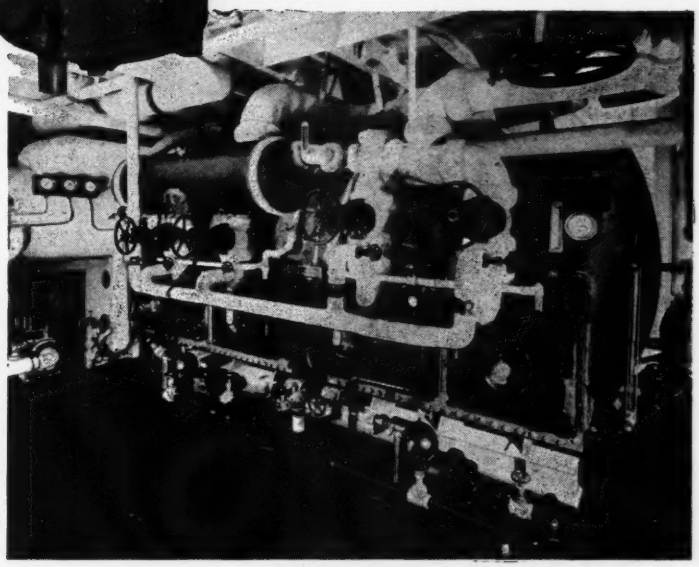
2 Low operating temperature and pressure means less scale, soft and easily removable by shock scaling.

3 Large temperature head permits use of smaller, less expensive evaporators.

4 Purer distillate is guaranteed at lower cost.

Simple and multiple effect units, providing from 12 to 80 tons per day or more, are built to meet individual requirements. Write for new bulletin giving installation diagrams, cost data and construction details.

Photograph and sectional view of a single-effect 12 and 20-ton Conseco Evaporator with integral distiller condenser. Lower section illustrates our exclusive internal vapor baffling and combined vapor feed heater with distiller condenser in dome of one piece unit.



Installation of 80-ton low pressure double-effect Conseco Evaporator. Photo shows automatic liquid level controls, automatic drainers, distiller condenser with instrument panel, and vapor feed header. Note simple piping and valve arrangement.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

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TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS
CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

MANUFACTURERS' *Personals*

The American Engineering Co., Philadelphia, announces the following appointments: F. C. Messaros, Chief Engineer; J. S. Frame, Chief Draftsman. Both Messrs. Messaros and Frame have been with the company over 20 years.

Frank D. Evans has been appointed assistant Chicago district purchasing agent by American Steel and Wire Co., U. S. Steel Corp. subsidiary.

Kenneth K. Boynton has been elected vice-president of International General Electric Co., Inc., and will be in charge of I. G. E.'s relationships with associated companies in Europe.

Joseph Bronaugh has been named manager of a newly established Miami branch office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., at 1404 Postal-Pacific Bldg., Miami, Florida.

Russell L. Peck has been appointed refractories engineer by Norton Co., Worcester, Mass. He will work with F. E. Leiby and will cover Philadelphia, Delaware, Eastern Maryland, Eastern Virginia and Eastern North Carolina.

Harry E. Smith of the Raybestos-Manhattan, Inc., Manhattan Division, Passaic, N. J., Corporation vice president, has been selected to be in complete charge of corporation rubber product sales and marketing and freed from other responsibilities.

Corning Glass Works of Corning, N. Y., has announced the election of Gordon S. Rentschler, chairman of the National City Bank of New York, and George Murnane, partner, Lazard Freres and Company, as directors of the Corning Glass Works. Both of the new directors have long been identified with leading American financial and business institutions.

Lt. Col. T. H. Daugherty, who has recently returned to civilian life and come back to his old company, the Hagan Corp., has been appointed to be assistant to Dr. Everett P. Partridge, Director of Research of Hall Laboratories and Calgon, Inc. In his new post he will deal principally with problems involving industrial water chemistry.

P. H. Lair, industrial engineer and research consultant, has become manager of the New York sales office of the Dampney Co. of America with offices at 114 Liberty Street, New York City.

Frederick J. Bruckner has recently been appointed assistant manager of sales for the Chicago district of the United States Steel Supply Co. Mr. Bruckner joined the sales department in 1927 and has progressed through various positions in this department of the Chicago district. He was formerly manager of the alloy and aircraft steels division, a position which he held since 1943.

David W. R. Morgan, manager of the Steam Division of the Westinghouse Electric Corp., has been appointed general manager of the entire South Philadelphia Works, it has been announced. Mr. Morgan's responsibilities will include general supervision of the Aviation Gas Turbine Division, and the Attica, N. Y., plant of the Stoker Department. He will retain direct management of the Steam Division.

Cutler-Hammer, Inc., Milwaukee, Wis., announces three new appointments on its research and development staff. These appointments are: C. T. Evans, Consulting Engineer: C. W. Kuhn, Assistant Manager of Development; R. A. Millermaster, Assistant Manager of Development.

These three men have been members of the Cutler-Hammer Development Department for some years, and are intimately acquainted with the products and the duties for which they are now responsible.

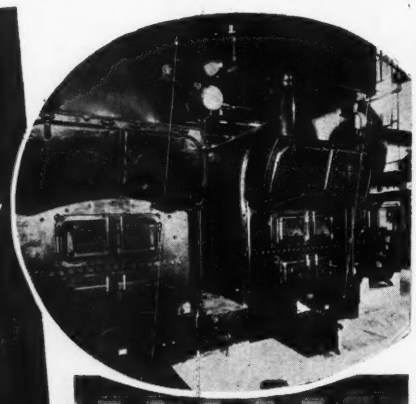
Russell W. Boettiger has been appointed sales manager of Leslie Co., Lyndhurst, N. J. Mr. Boettiger joined the Leslie organization in 1936 as sales and service engineer. Prior to that he was in plan engineering with General Foods Corp. In his new position, Mr. Boettiger will supervise the field sales and service activities of Leslie agents.

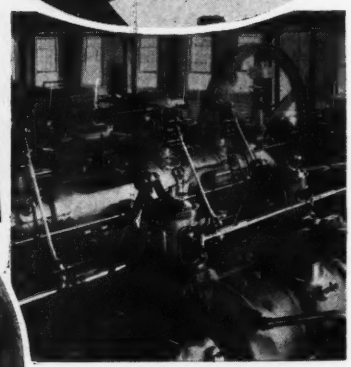
HAERING GLUCOSATES

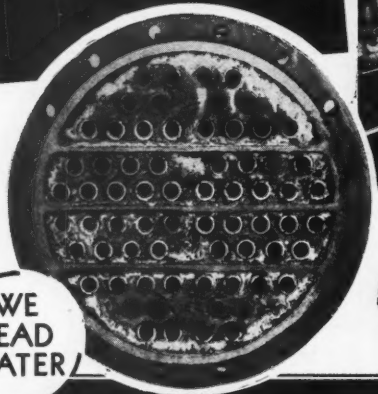
over a period of years have controlled

Corrossion, Scale and Algae

in INDUSTRIAL PLANTS







WE READ WATER

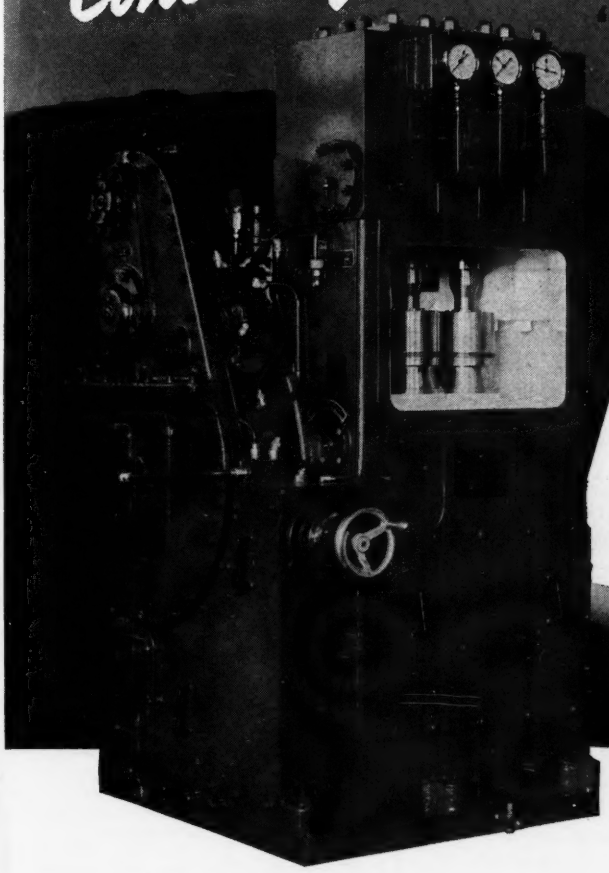
Write on your letterhead for the latest "H-O-H Water Studies"

D. W. HAERING & CO., Inc.

GENERAL OFFICES:

205 West Wacker Drive, Chicago 6, Illinois

Control of Delivery IS A SIMPLE MATTER . . . with ALDRICH-GROFF "POWR-SAVR" PUMPS



IN MEDIUM AND HIGH PRESSURE SERVICES

For

- *Boiler Feeding*
- *Desuperheater Feeding*
- *Process Charging*
- *Pipe Line Pumping*
- *Hydraulic Pressure*

Unique in their efficient use of power for variable delivery requirements, Aldrich-Groff pumps operate at constant speed and their power consumption is practically proportional to delivery. Users report substantial power savings as well as low maintenance expense.

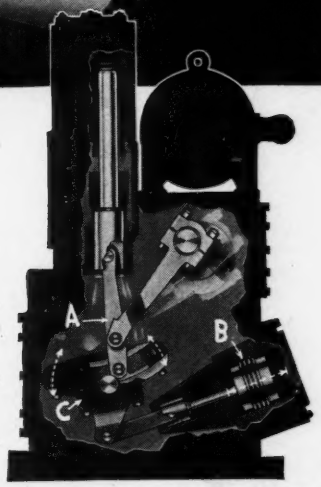
Discharge is varied manually or automatically, either at the pump or from a remote station. The variation is stepless from zero to full capacity.

Aldrich-Groff pumps are available in six standard sizes, ranging up to 100 bhp and to 15000 psi. Their use is increasing wherever power savings, extreme mechanical reliability and simple, accurate control of delivery is important. Over 300 units in successful operation for periods ranging up to 6 years.

For full particulars, write today for Data Sheet 65.

The Aldrich Pump Co., 7 Gordon Street, Allentown, Pa.

Representatives: Akron • Birmingham • Bolivar, N. Y. • Boston • Chicago • Cincinnati Cleveland • Denver • Detroit • Duluth • Houston • Jacksonville • Los Angeles • New York Omaha • Pittsburgh • Philadelphia • Portland, Ore. • St. Louis • San Francisco • Seattle • Tulsa



Power is supplied to plunger by connecting rod through a link (A). Length of plunger stroke is controlled by piston (B) which positions stroke transformer (C). In zero stroke position, the link has a pendular motion and the plunger is stationary. To increase delivery, the stroke transformer (C) is tilted, so that the link motion is given a vertical component which actuates plunger through any travel up to full stroke.

ALDRICH . . . *anticipates industry's pumping needs*

Wilmot F. Wheeler has been elected president of the American Chain & Cable Co., Inc., of Bridgeport, Conn., succeeding the late William T. Morris. Mr. Wheeler has been with the company since 1916, was elected a director in 1919 and treasurer in 1920. He has been executive vice president and treasurer since 1936. Cyrus F. Johns becomes executive vice president and Stanley Mann treasurer.

Northern Equipment Co., Erie, Pa., has appointed The Kissick Co., 1524 Chestnut Street, Philadelphia, Pa., as sales and service representatives for Copes feed water regulators, pump governors, desuperheaters and allied equipment. The territory served includes Southern New Jersey, Southeastern Pennsylvania, Eastern Maryland and Delaware.

New ENGINEERING BOOKS

Plastics Mold Engineering, by J. H. Dubois and W. I. Pribble. Copyright 1946, 6 by 9 in., 471 pages, illustrated, cloth cover, published by American Technical Society, 58th and Drexel Avenue, Chicago, Illinois. Price $7.00.

Design and use of the important types of plastic molds are the subjects of this book. It brings out details of the mold-making practices heretofore considered trade secrets with the object of contributing to the prosperity of the entire plastics industry. It is addressed primarily to the user of plastics—the production engineer and executive—rather than to the research chemist or manufacturer of plastic materials.

The text covers production methods, individual types of molds, specific molding processes, procedures and calculations in mold design, raw materials and product design, and maintenance and repair of molds.

This text should prove particularly helpful to those just entering the plastics field who wish to make a serious study of various phases of the industry.

These phases are discussed in order under the following chapter headings: Plastics Molding; Plastics Product Design; Types of Molds; Tool-Making Equipment and Methods; Materials for Mold Making; Designing and Drafting Practice; Compression Molds; Transfer Molds; Injection Molds; Cold-Mold and Extrusion Die Design; Special Fixtures; Mold Sampling and Maintenance.

Catalytic Chemistry, by Henry William Lohse. Copyright 1945, 6 by 9 in., 416 pages, illustrated, cloth cover, published by the Chemical Publishing Co., Inc., 26 Court Street, Brooklyn 2, New York. Price $8.50.

Engineers are always hearing talk about the almost magical things called catalysts and their uses in various industrial process. The word catalyst has even crept into social and political discussion by laymen. Catalytic processes during the war have done spectacular things.

Yet, beyond the more statements that catalytic processes are employed in producing well-known or new materials—i.e., the Houdry process for high-octane gasoline, few people except chemists really know much about them. Most of us know—or think we do—that a catalyst is a substance whose presence improves a chemical reaction or causes one to take place merely because of the presence of the catalyst, which does not enter into the reaction at all. But just what are these catalysts, how do they work, how are they used? This book gives the real technical and chemical answers to these questions.

Consequently, for engineers and others in industry who have a good foundation of chemistry, this book should prove very valuable in extending their understanding of modern industrial operations. Those who know little chemistry, however, will have some difficulty with it.

Particular emphasis is given to the subject of impurities in catalytic reaction systems and to the role of traces of other metals in silver, copper, iron, nickel, etc. used as catalysts.

The way in which the author treats the subject is indicated by the main chapter headings: Brief History of Catalytic Chemistry; Catalytic Theory; Nature and Properties of Catalysts, Specific Types of Catalytic Reactions, Industrial Catalytic Reactions.

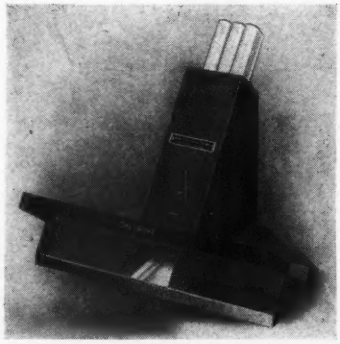
PROTECT

your boilers

and condensers

the easiest way

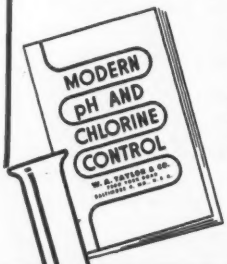
with the



TAYLOR WATER ANALYZER

A Taylor Water Analyzer allows you to make a periodic three-minute check on silica in your boiler water and ammonia and pH of condensate, without the need of handling fragile Nessler standards. For Taylor Standards are enclosed in plastic slides . . . they're *accurate* . . . and they carry an UNLIMITED GUARANTEE AGAINST FADING! Elimination of one boiler shut-down will save many times the moderate cost of a Taylor Water Analyzer.

For top performance, you should also use a Taylor Phosphate Comparator. Using the same type of plastic color standard slide, you can obtain an accurate phosphate reading in two minutes. The method employed avoids interfering reactions with constituents other than phosphates . . . gives you *true* values.



Taylor Water Analyzer.....$18.00
Extra Color Standard Slides,.....each 8.00
High and Low Phosphate Comparators, ...each 19.00

See your dealer today, or drop a card in the mail for Taylor's authoritative 88-page book, "Modern pH and Chlorine Control".

W. A. TAYLOR AND CO.
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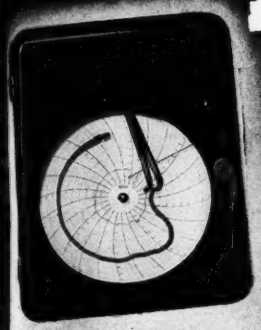
Prevent Runaway Losses



Specify LADISH Forged Steel Fittings

Insure economy in piping installations through the use of Ladish Controlled Quality Forged Steel Fittings. Sharp, clean cut threads machined to exacting tolerances, together with the added strength and endurance afforded by *Controlled Quality* Ladish Forged Steel Fittings assure years of trouble-free, efficient operation and freedom from costly fittings failures.

Machined from drop forgings—Ladish Controlled Quality Fittings give you the ultimate in satisfaction, economy and dependability.

Write for your copy of Ladish Forged Steel Fittings Catalog Volume 2.

- RESISTANCE TO STRAINS of expansion and contraction over wide temperature ranges is measurably improved with the tougher, more compact grain structure provided by Drop Forging.
- RESISTANCE TO FATIGUE is accomplished by accurately controlled grain flow for maximum strength at vital points provided by Drop Forging.
- RESISTANCE TO SHOCK PRESSURES is materially improved by increased dynamic strength and toughness of metal produced by Drop Forging.
- FREEDOM FROM INTERNAL DEFECTS is assured by the denser, more homogeneous metal structure of Drop Forgings.

UNIFORM WELDABILITY . . . FREEDOM FROM LEAKS . . . LONGER LIFE

Controlled Quality

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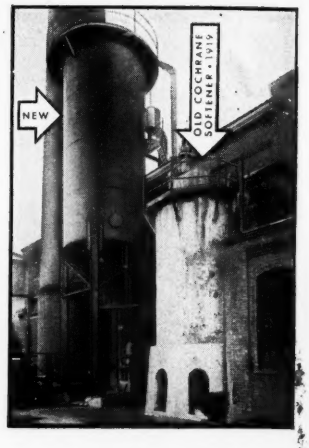
TO MARK PROGRESS

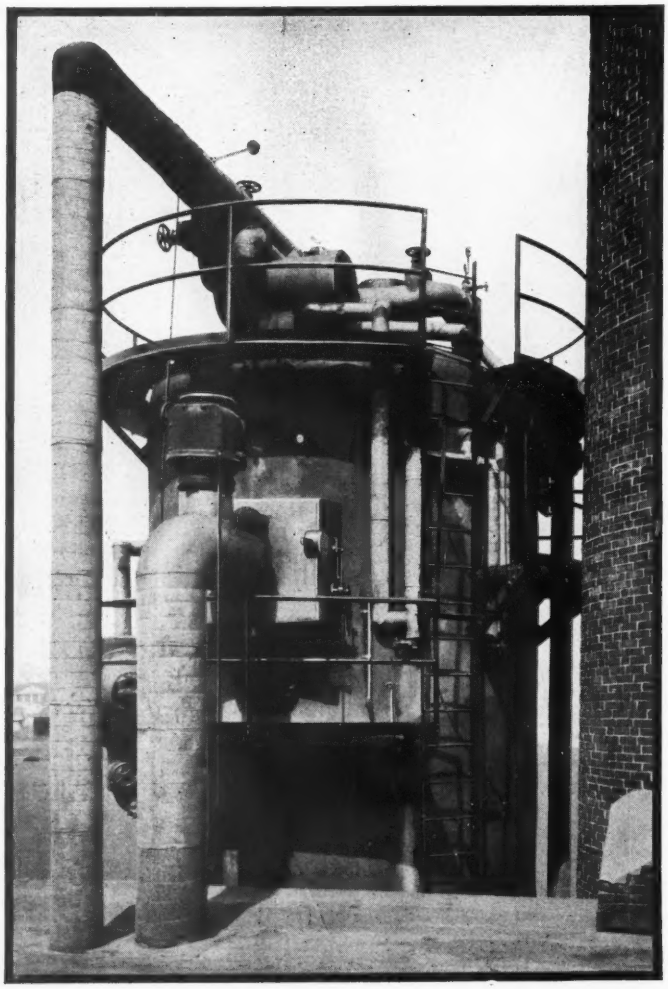
Above: Cochrane Flow Meter Panel for Automatic Control of Chemical Feed.

HISTORY REPEATS

(and Cochrane Water Conditioning Equipment)



COCHRANE Water Conditioning Equipment does its work so thoroughly, so efficiently and with so little extra upkeep costs that "repeat" orders are the rule rather than the exception. The Deaerating Hot Process Softener shown in these photographs was ordered to replace the old Cochrane Hot Process Softener shown alongside it. This older piece of equipment is still functioning, but was not able to handle the increased load. At last reports it was destined to be shifted to another job. Write for details of this installation and facts about Cochrane Hot Process Water Softeners. Cochrane Corporation 3123 N. 17th St., Philadelphia 32, Pa.



Left: Upper part of Softener showing Deaerator Mechanism and Cochrane Multisport Relief Valve.

COCHRANE

Now... Precision Castings in MONEL, NICKEL and INCONEL

You already know the many tough jobs that you've licked by using strong, hard, corrosion-resisting INCO Nickel Alloys.

Now... comes a development that *extends* the usefulness of these problem-solving alloys.

Precision castings are now being produced by INCO in Nickel, Monel, Inconel and other high-Nickel alloys.

That means designers and engineers can use these rustless alloys in complicated shapes which frequently were not practical or economical to obtain as sand castings or by machining from forged stock.

The illustration shows the flexible design possible. Note the holes, slots, undercuts, vanes, wing sections, gear teeth and threaded sections that can be produced with hair-tolerances and fine finish... *without machining or grinding.*

Both manufacturers and users of power plant equipment profit by this development. To the *manufacturer*, it means a chance to use INCO Nickel Alloys in more economical forms. To the *user*, it means broader protection against stress... corrosion... erosion... high temperatures ... abrasion.

INCO TRADE MARK

The International Nickel Company, Inc., 67 Wall St., New York 5, N.Y.

Precision Castings *in* INCO NICKEL ALLOYS

—a new way to lengthen equipment life

MONEL* • "K" MONEL* • "R" MONEL* • "KR" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL

*Reg. U. S. Pat. Off.

LIQUID OR GAS TEMPERATURE CONTROL PROBLEM?

These publications describe the NIAGARA AERO HEAT EXCHANGER and some of its applications. It accurately regulates the temperature of gases and liquids. Industrial plants using chemical and heat-treating processes have gained extra benefits from using this equipment wherever cooling water is used or any fluid is cooled to exact temperatures.

Some of the applications are: controlling temperature of liquid chemicals and intermediates in process; controlling jacket water temperature in power and process equipment; regulating the temperature of controlled atmosphere; controlling liquid bath temperatures.

As a cooler, the NIAGARA AERO HEAT EXCHANGER saves the cost of 95% of the water circulated.

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Applied Energy Conversion, by Bernhardt S. G. Skrotzki and William A. Fopat. Copyright 1945, First Edition; 6 by 9 in.; 509 pages; illustrated, cloth cover; published by the McGraw-Hill Book Co., Inc., 330 W. 42nd Street, New York 18, N. Y.

This book is intended by the authors to be a background text in the power field, and it presents a good overall picture of the modern situation.

The text is essentially divided into two parts, the first dealing with an up to date study of the major power plant equipment, and leading logically into the development of the central station and the industrial plant from the combination of this major equipment. The second part deals with the economics of the power field.

This section on economics is more comprehensive than any the reviewer has seen. It begins with a study of fundamental economics which should provide a good review for the man who has studied the fundamentals of this subject—no more than high school economics is needed—and a good introduction to the subject for one who has not been previously acquainted with it.

After establishing a foundation with this fundamental course, the authors go on to develop the subject of power plant costs explaining the parts played by capital costs, depreciation, taxes, insurance, fixed charges, fuel, operating labor, maintenance labor and materials, supplies, and supervision. Methods of economic selection are discussed, and in this section is presented the controversial problem of purchased power versus generated power.

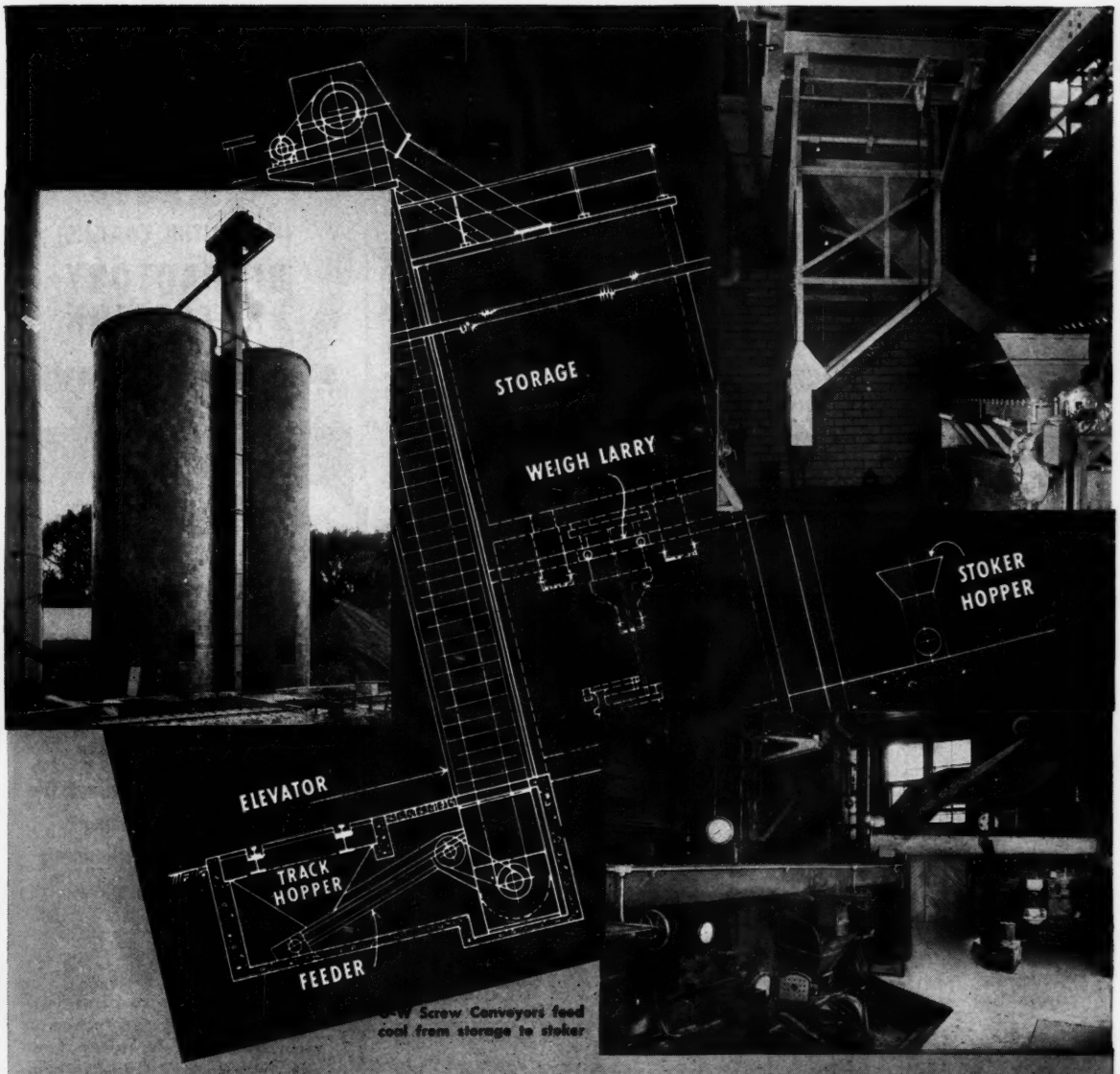
In the next chapter load curves are discussed with a presentation of several different types, including a discussion of demand factor, diversity factors, load factor, capacity factor, utilization factor and their influence on plant design.

In the chapter entitled, "Selection of Plant," the subjects of plant capacity, plant location, equipment selection, equipment costs and plant costs are all evaluated and compared, showing the influence of each on the final decision for design of the plant.

Chapter 13 is on station performance and operation characteristics, discuss in turn, performance characteristics, performance data, average heat rates, load division, station performance characteristic, station incremental rate, capacity scheduling and hydraulic station operation.

The final chapter is devoted to the study of energy rates, and in it the authors discuss the general rate form, and various practical forms of rates, concluding with the subject of rate readjustments.

The following list of chapter titles shows the subjects covered in this text. Raw Energy, Steam Power Plant—Combustion Theory and Equipment, Steam Power Plant — Steam - Generating Units, Steam Power Plant—Prime Movers, Steam Power Plant—Condensate and Feed-Water Systems, Steam Power Plant—Application, Diesel- and Gas-engine Plants, Hydraulic Power Plants, Power Plant Developments, The General Economic Problem, Load Curves, Selection of Plant, Station Performance and Operation Characteristics, Specific Economic Energy Problems, and Energy Rates.



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OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE

HELPFUL BULLETINS

(Continued from page 34)

67 **Air Purifier**—A new Pur-O-Fier, designed to eliminate free moisture, oil and all foreign matter with a heavier specific gravity than air, from passing into the compressed air lines, is described in a bulletin just issued. It is pointed out that this new device is extremely sensitive to the slightest movement of air. Applications for the purifier are described and listed. Bird-White Company.

68 **Clamps and Fittings**—Clamps and fittings for use with hose, for splicing wire and cables, for making flexible cable line taps, for repair of semi-permanent wooden members, for clamping insulated guy wires, for splicing electric welding cable and many other uses are clearly detailed, by drawings and explanation. The book also shows repairs to truck handles, ladder rungs, posts, line poles, stage planks, needle beams, etc. Punch-Lok Company.

69 **Metal Selection Guide**—List "B-100" contains more than 100 technical bulletins and publications that explain the properties, corrosion-resisting characteristics, and practical applications of Inco Nickel Alloys. The International Nickel Co., Inc.

70 **Turbine Oil Booklet**—Operating characteristics and advantages of Gulfcrest Oil for steam turbine lubrication are described in a handsome new booklet just issued by Gulf Oil Corp. Among subjects treated are: 1. How air is actually beneficial to Gulfcrest Oil under service conditions in a steam turbine, since it permits oxidation to proceed just far enough to produce additional oiliness; 2. How the Alchor process of refining makes this lubricant highly responsive to oxidation and corrosion inhibitors.

71 **Heat Insulation**—"Heat Insulation for Industry" is the title of this new insulation catalog. It has been developed to facilitate the specification and purchase of heat insulation for industrial and commercial use. The book also offers other helpful and practical data—heat loss tables, selection charts and data for determining insulation thickness. Materials include: magnesia, asbestos, sponge, diatomacious earth, calcined aggregate and others. Philip Carey Mfg. Co.

72 **Technical Books**—A new catalog of technical books has been issued by The Chemical Publishing Company, Inc., 26 Court St., Brooklyn 2, N. Y.

73 **Industrial Research**—Attractively illustrated bulletin describes the background and function of Arthur D. Little, Inc., as a consulting laboratory. Research covers improvement of mechanical, electrical, electronic, hydraulic and chemical equipment.

74 **Power Hammer for Blacksmith Shops**—"The Mechanical Blacksmith's Helper" is the sub-title of a new bulletin describing the McKiernan-Terry Blacker power hammer. This direct-geared electric-power-driven hammer enables one smith alone to handle any hand-forging operation without helpers. Gives detailed description of the hammer's construction with its specifications, supplemented by a concise tabulated list of the advantages and savings claimed for it.

75 **Management Engineering**—A new 20-pg. brochure, just published by Methods Engineering Council, describes in detail the functions of modern management engineering. Includes a section on general management services, followed by discussions of the Council's work in methods engineering, training, plant layout and design, job evaluation, wage incentive plans, and personnel appraisal. Makes liberal use of charts, which clarify the steps in each of these management services. Also listed are 99 separate services included in the scope of Methods Engineering Council's operations.

76 **Stud Welding Manual**—Nearly every page of this book describes a different application of the company's stud welder. For example: securing wood decking to steel; securing insulation material to steel; the use of metal lath studs, lagging studs, hook stud and eye-bolt stud, cargo batten studs, grooved studs, rectangular metal lath studs, reduced base studs, etc. Effectively illustrated. Nelson Sales Corporation.

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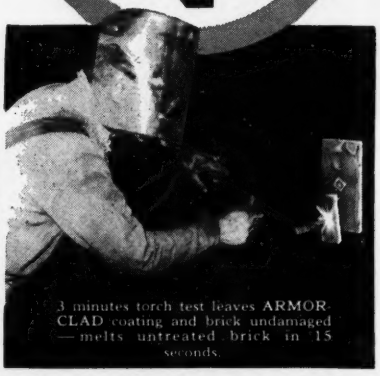

3 minutes torch test leaves ARMOR-CLAD coating and brick undamaged — melts untreated brick in 15 seconds.

1. Adds 50% to 200% to wall life
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3. Eliminates costly shutdowns
4. Easily and simply applied.

Crucial tests prove the ability of ARMOR-CLAD to lengthen furnace-lining life 50% to 200% under actual service conditions. Full, long-lasting protection is assured in temperatures from 1500° to highest furnace temperatures, with absolute freedom from spalling, slag adhesion or penetration of flame, gas or slag. Simple to apply by brushing or spraying — ARMOR-CLAD forms an impervious, resilient, vitreous coating completely sealing joints, pores and cracks in refractory linings, and is applicable to new or used furnaces.

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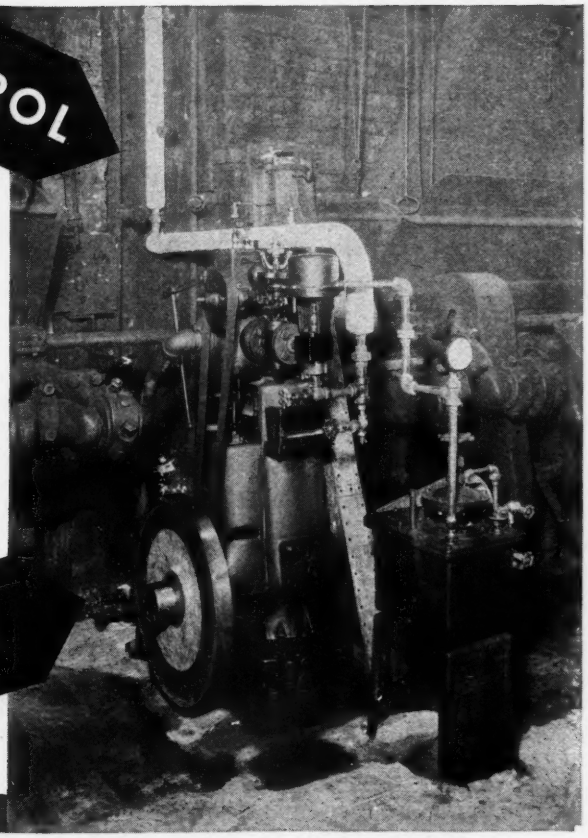
TROY-ENGBERG STEAM ENGINE

CLOSE SPEED CONTROL

IS THIS WHAT *You* WANT?

WIDE SPEED RANGE



The steam engine can idle along or can turn over at top rated speed which is many times the speed of idling or it can be set at any intermediate speed.

This is one reason why you will find Troy Steam Engines on so many stokers, particularly those with widely varying boiler loads. And this same flexibility coupled with close speed control makes the steam engine very useful for driving other equipment which operates with variable speeds.

Industry has plenty of such installations... and plenty of use for the modern Steam Engine.

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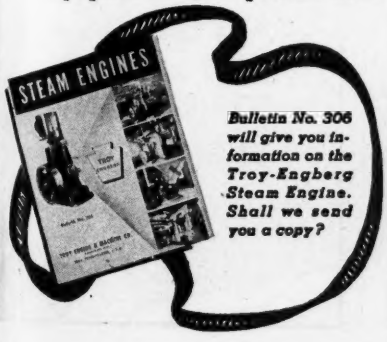

Bulletin No. 306 will give you information on the Troy-Engberg Steam Engine. Shall we send you a copy?

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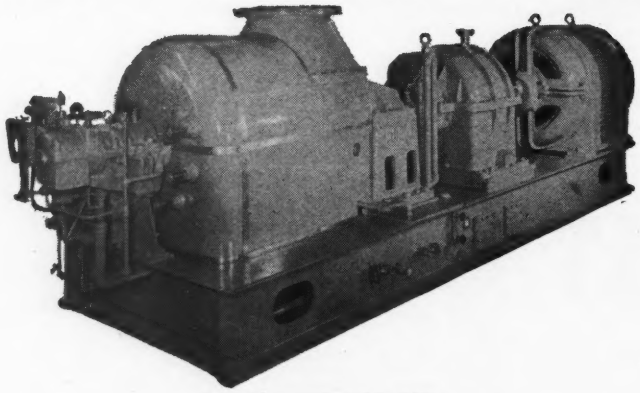

500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

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Mechanical drive turbines, horizontal and vertical Reduction Gears — Steam Boilers

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with experience in steam power plant layout, power piping and plant survey work. A good opportunity for the right man with a small consulting firm in the Midwest. Answer to Box No. 1505, giving age, outline of experience, education and salary expected.

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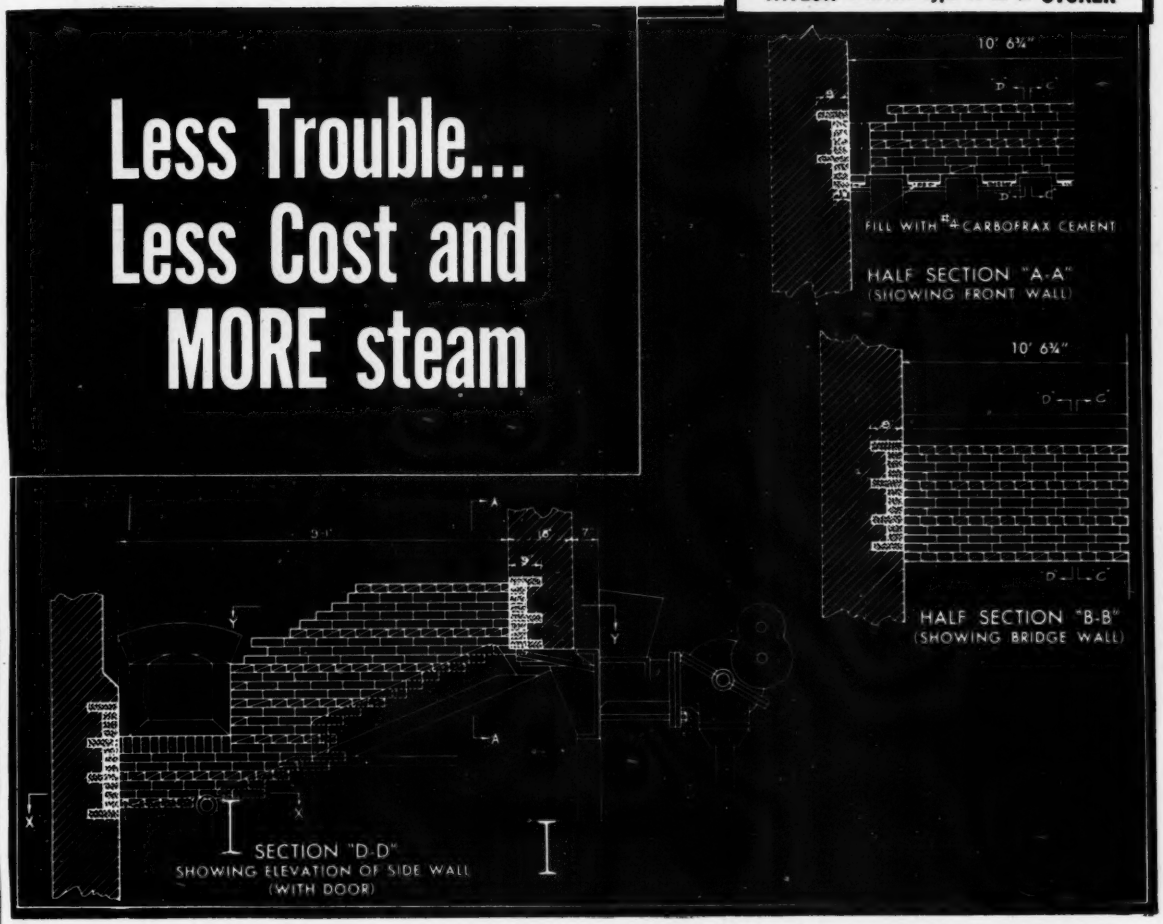
Less Trouble... Less Cost and MORE steam



Specifically engineered for greatest efficiency is the CARBOFRAX silicon carbide brick setting for use with a Type HC-6 Taylor Stoker. Although actual coverage is determined by operating conditions the major benefits of a CARBOFRAX lining are less trouble, less cost and *more* steam.

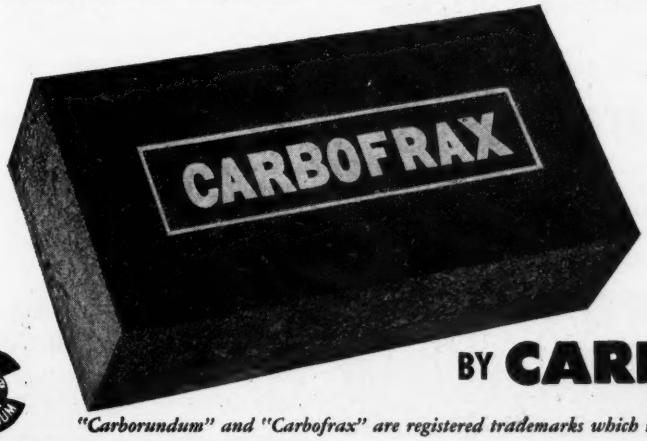
LESS TROUBLE is a basic advantage thanks to the fact that troublesome clinker formations cannot anchor on the surface of CARBOFRAX brick. As these brick do not soften even at extremely high temperatures the moving fuel bed tends to keep the walls clean. Any accumulations that may remain are easily barred off.

LESS COST is a two-fold proposition. There's a substantial saving resulting from the better fuel combustion. And the long life of CARBOFRAX linings is a strong economic point. 8 to 10 years service without replacements of these brick is not exceptional.

MORE STEAM results for two reasons. First, the entire grate area is utilized; and secondly, furnaces are kept in steady, continuous operation. Outages for lining repairs are rare, and on-line service is the order year in and year out.

It pays well to fully investigate the advantages of super refractory CARBOFRAX settings. Their high refractoriness, great strength, and resistance to mechanical and flame abrasion are specific benefits which lead to a better operating report.

An illustrated technical booklet entitled "CARBOFRAX in Boiler Furnaces" contains information of value to you. We'll send a copy promptly, if you'll just write to Dept. H-46, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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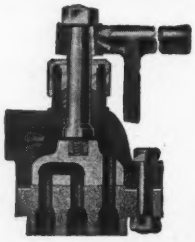

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Featuring specially treated extra hard seats that don't cut out and a simplicity of design that minimizes trouble, Nicholson cylinder control valves are setting new records for long wear in many plants. Precision-made throughout to give maximum exactness of control and regulation.

Custom Construction to Meet Your Specific Needs

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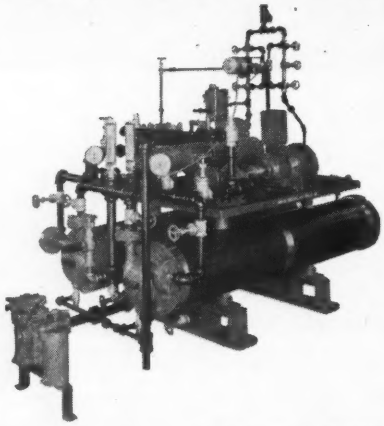

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Ready to Run

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To Specification

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50 to 5000 Gal. per hour

AUTOMATIC
Delivers fuel oil to burners at proper pressure and temperature

FUEL OIL PUMP AND HEATING UNITS

Single or Duplex Steam or Electric Pumps.
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TIME TESTED—through years of continuous service, our units have proved their worth.

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Used by all industries for better boiler operation and for improved furnace operation—XZIT is a proved product. Write for demonstration or order a trial supply. There is an XZIT representative near you.

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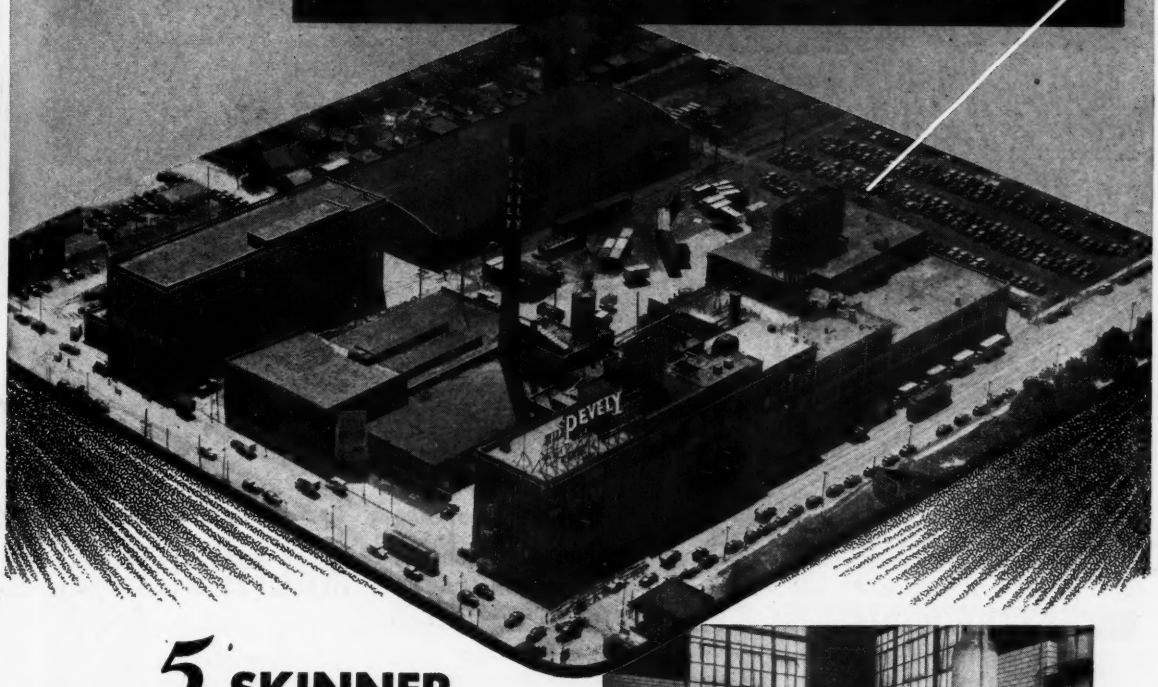

5 SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

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THE famous Pevely Dairy was founded by Martin W. Kerckhoff way back in 1887, when most St. Louis residents still kept a cow in the back yard. In 1899 Mr. Kerckhoff pioneered the use of glass bottles, and planned his own bottling machine. He lived to see the ground broken for the first buildings of the present great plant, in 1916. Five grandsons still maintain the family tradition of progressive innovation and expansion.

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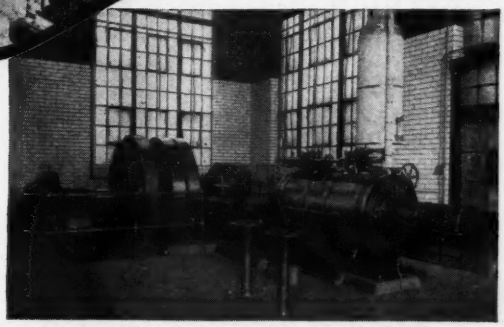

The original 300-kw. "Universal Unaflow" engine-generator unit in the Pevely plant

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• One industrial plant increased its coal-pile depth from 48 to 116 feet, and boosted pile capacity from 39,000 to 150,000 tons in limited space. Although probably the highest coal pile in the world, fire hazard is actually reduced because pressure within the pile minimizes the air content.

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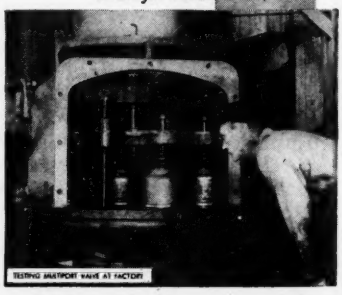

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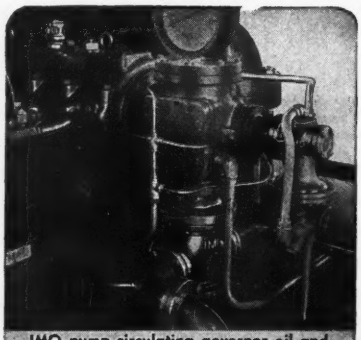

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The IMO PUMP requires less space than most other pumps because of the high capacity attainable by its efficient, compact design and high speed operation. If desired, it can be directly connected to, and mounted upon, turbines, motors, engines, or other equipment. In special designs, dimensions and proportions can be varied to meet space limitations. I-128

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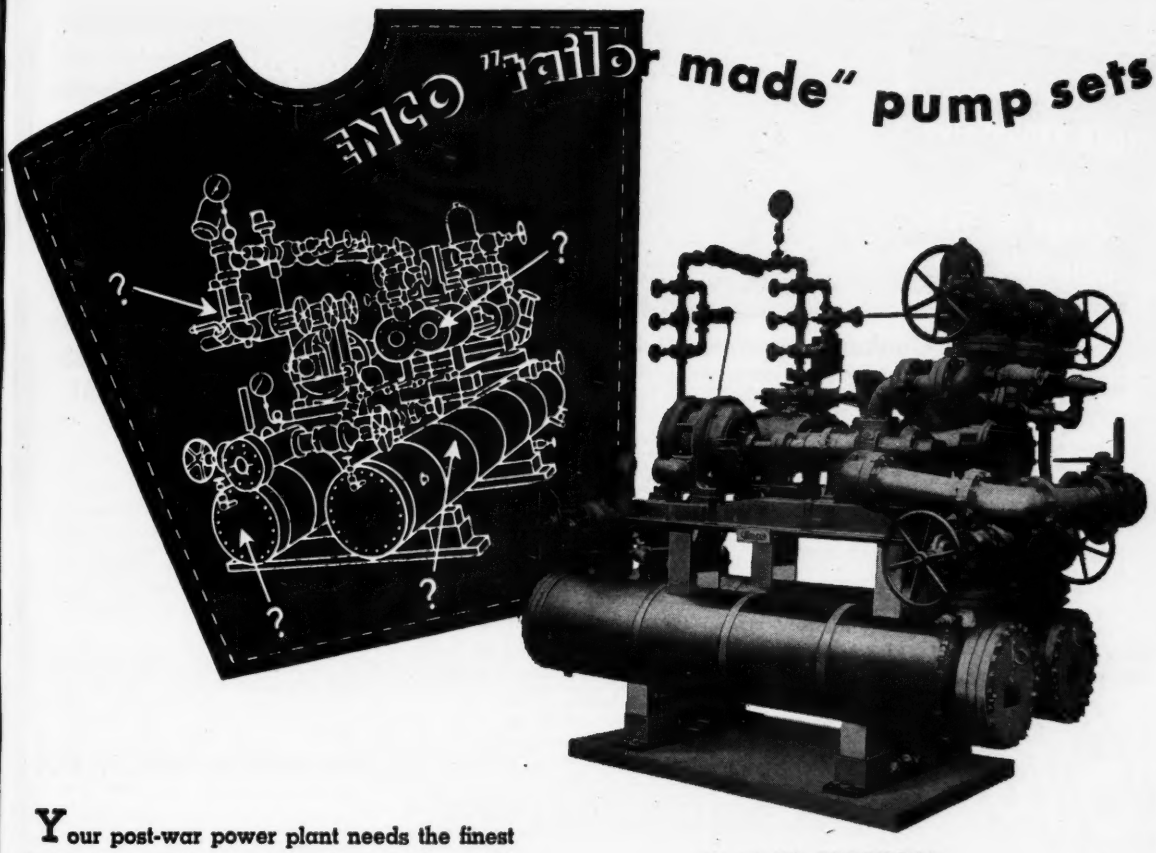

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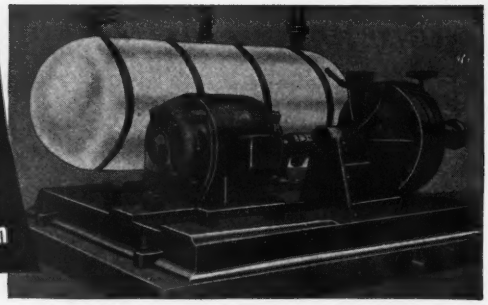
STOUT NO-VENT
Boiler Return System



—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

High temperature direct return saves fuel. Often 25% or more. (This would offset the 20% cut expected in soft coal deliveries to industry as announced July 14th by Secretary Ickes.)

Improved circulation the Stout NO-VENT way uniformly increases the temperature in steam heated units and increases production. Reducing boiler load and returning distilled water prolongs boiler life.

If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

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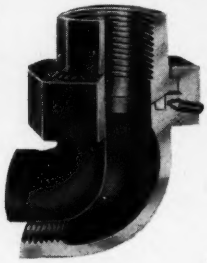
Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

Stout
NO-VENT BOILER RETURN SYSTEM

Simplify YOUR PIPING MAINTENANCE

with **JEFFERSON UNIONS**



with the **RECESSED BRASS SEAT**

The *brass-seating feature* of all Jefferson Specialty Unions means important savings in piping maintenance because there are fewer joints involved at points where unions are used; also guards against shutdowns because it gives leak-proof tightness without undue pressure.

The 90 deg. Union Elbow shown is representative of the complete line of Jefferson Specialty Unions to meet all piping applications. Write for descriptive catalog or get in touch with your nearest distributor.

JEFFERSON UNION CO.
601 West 26th St., New York 1, N. Y.
Factories at Lexington 73, Mass., and Lockport, N. Y.

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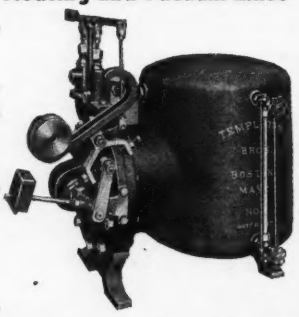
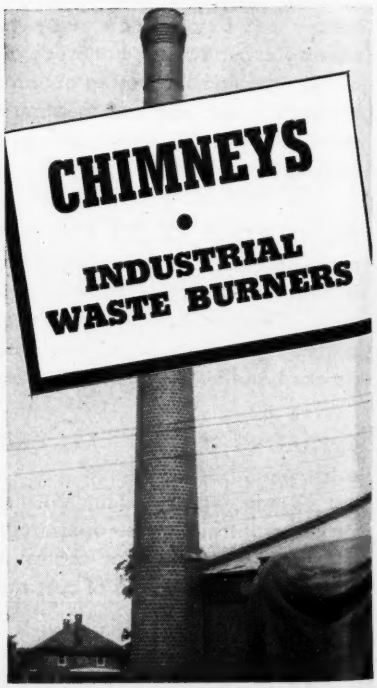
for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

Pumps Water at any temperature or pressure.
Open float cannot burst or waterlog.
Valves and Seat Bronze or Stainless Steel.
Sizes 1 in. to 4 in. inlet and outlet.
Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.
699 Main St. Walpole, Mass.



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FIRING SYSTEMS • SAWDUST BURNERS

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Further information gladly submitted on request

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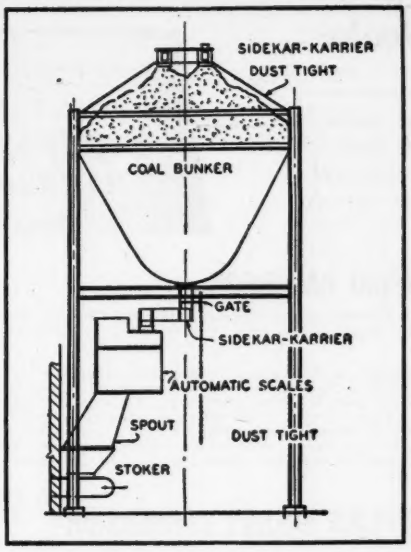
Simplicity

FEATURES THE

LINK-BELT

SIDEKAR-KARRIER

Boiler Room Conveyor

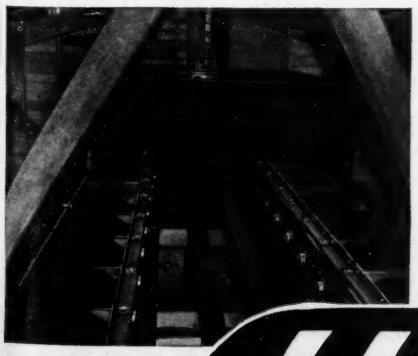


Lower Cost—Improved Coal Handling

An effective solution to the problem of cutting boiler room coal handling costs is afforded by the LINK-BELT SIDEKAR-KARRIER "run-around" conveyor.

The conveyor design is characterized by extreme simplicity. A single strand of chain carries the buckets, which operate on rollers. Especially adapted to boiler plants equipped with overhead bunkers and stoker spouts, for the installation of individual weigh scales. Requires only one to two ft. of head room.

Other advantages: 1) Uniform feed within a horizontal path of travel, 2) Automatic discharge to several points, 3) Surplus material is recirculated in buckets until a new discharge point is found, 4) There is virtually no segregation or degradation in the conveyor, 5) Buckets and spouts are self-cleaning, 6) Less abrasion means longer life, 7) Horsepower requirements are low, 8) Conveyor is enclosed, no dust leakage. The SIDEKAR-KARRIER is adapted to a wide range of capacities and conveyor lengths.



Above — Shows idler-sprocket end of SIDEKAR-KARRIER installation handling coal.

The drawing at the top shows a typical installation of a coal bunker equipped with a dust-tight SIDEKAR-KARRIER, with a similar unit feeding to the automatic scales.

• • •

Engineering details and scope of application of the SIDEKAR-KARRIER are illustrated in Folder No. 2068, which will be sent on request.

10,242

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

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SIDEKAR-KARRIER

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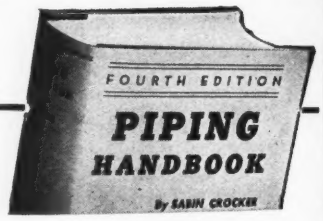

1. PIPING HANDBOOK

By SABIN CROCKER, Senior Engineer, Engineering Division, The Detroit Edison Company. *Fourth edition*, 1376 *pages*, 4½ x 7½, 334 *illustrations*, 329 *tables*. $7.00.

Makes available to the engineer, designer, and contractor a vast compilation of data necessary to the effective use of piping in all its engineering and industrial applications—steam and power plant piping, heating and plumbing systems, oil and gas piping—everything from water distribution to hydraulic systems for airplanes. Covers scientific fundamentals, materials, and design and installation practice, and gives many useful and dependable construction details, cost analyses, dimensional standards, material specifications, definitions, charts, formulas, etc.

2. APPLIED ENERGY CONVERSION

A Text in Power Plant Engineering

By BERNHARDT G. A. SKROTZKI, Assistant Editor, *Power*; formerly, Assistant Engineer, System Engineering Department, Consolidated Edison Company of New York, Inc.; and WILLIAM A. VOPAT, Assistant Professor of Mechanical Engineering, The Cooper Union School of Engineering. 509 *pages*, 5¾ x 8¼, 209 *illustrations*. $5.00.

Covers the equipment and economics of industrial and central station power plants, describing the characteristics and performances of the major elements, and discussing the coordination of equipment for the generation of energy from a physical and economic viewpoint. Developments in gas turbines and wind turbines, as well as special and European types of steam generators are included.

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A practical book giving the operating engineer an exceptionally clear and simple presentation of the principles of design, construction and operation of steam boilers and their accessories. These concise, easily understood questions and answers are designed particularly to help power plant men and students studying for operating engineers' certificates, and to provide ready reference material for everyone concerned with practical problems of boiler-room practice.

4. MARINE ENGINEERS' HANDBOOK

J. M. LABBERTON, Editor-in-Chief, Lieutenant Commander, USNR; Professor of Marine Engineering, New York University. Prepared by a Staff of Specialists. Includes the general engineering fundamentals reproduced from Mechanical Engineers' Handbook (LIONEL S. MARKS, Editor-in-Chief). 2013 *pages*, 4½ x 7, 1250 *figures*, $7.50.

A gigantic store of useful facts and data for design and operating engineers authoritatively covering every aspect of shipbuilding design. Every detail of information needed on the job is here — careful and accurate descriptions a wealth of illustrative figures and diagrams, useful tables and charts, needed formulas — sizes, weights, dimensions — proportioning of parts — elements of machinery, power, hull, propulsion, ship apparatus. Fourteen big sections divide the material into convenient related groups, and each chapter has been prepared by a prominent engineer specializing in that field.

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POWER PLANT *Construction News*

Ala., Mobile—Southern Kraft Div., International Paper Co., plans installation of electric power equipment in connection with expansion and improvements in kraft pulp and paper mill. Several new buildings will be erected. Entire project will cost about $1,000,000. Main offices are at 220 East 42nd St., New York, N. Y.

Calif., La Sierra—Loma Linda Food Co., Pierce St., La Sierra (Riverside County), prepared food products, plans installation of electric power equipment in new additions to plant, comprising several buildings for processing and packing service. Cost about $250,000, with machinery. Work will begin soon.

Ill., Kankakee—American-Marietta Co., Inc., 43 East Ohio St., Chicago, Ill., paints, enamels, synthetic resins, etc., plans installation of electric power equipment in two new three-story additions to plant on Greenwood Ave., Kankakee, each about 100 x 100 ft, reported to cost over $275,000. Work on superstructure will begin soon.

Iowa, Denison—Municipal Light & Power Dept., plans expansion and improvements in municipal steam-electric generating station. Equipment will be installed for increased capacity. Cost reported about $250,000, with equipment. An engineer is being engaged to make surveys and plans.

Md., Baltimore—Glidden Co., 6401 St. Helena Ave., paints, varnishes, oils, etc., plans installation of electric power equipment in connection with proposed rebuilding of portion of plant recently destroyed by fire, with loss reported over $750,000. Main offices are in Union Trust Bldg., Cleveland, Ohio.

Mass., Boston—Boston Edison Co., 39 Boylston St., is arranging an appropriation of about $10.500.000, for expansion and improvements in plans and system during coming year, including station betterments, transmission and distribution lines, power substations and other facilities. Work will begin at early date.

Minn., Blooming Prairie—Municipal Light & Power Dept., is considering extensions and improvements in oil engine-operated municipal power station, including installation of equipment for increased capacity. Cost estimated close to $100,000.

Minn., Fairmount—Municipal Power Dept., has plans under way for expansion and improvements in steam-electric power plant, including new addition to building for steam division and installation of boiler and other equipment. Estimated cost about $110,000. Proposed to carry out work in spring. Frank O. Jones is city engineer.

Minn., St. Paul—Theodore Hamm Brewing Co., Payne Ave., plans new boiler house at brewery, estimated to cost about $175,000, with boilers and auxiliary equipment. C. H. Johnston, Empire Bank Bldg., is architect; and Gausman & Moore, First National Bank Bldg., engineers, both St. Paul. Work on superstructure will be placed under way soon.

Miss., Natchez—Johns-Manville Corp., 22 East 40th St., New York, N. Y., wallboard, asbestos and allied products, plans new insulating board mill near Natchez, where large tract of land has been secured. It will comprise several large production buildings, with rated output of about 200,000,000 sq ft per annum. Electric power equipment will be installed. A power substation and boiler house will be built. Entire project reported to cost approximately $5,000,000. Work will begin soon.

N. J., Dover—New Jersey Power & Light Co., Dover, is arranging an expansion and improvement program in power plants and system to cost approximately $3,000,000 over a 36 months' period, including transmission and distribution lines, power substations and other operating facilities.

N. Y., Brooklyn—Service Backing Corp., 211 60th St., rubberized products, plans installation of electric power equipment in new two-story factory at 5901-11 Second Ave., estimated to cost about $215,000. Erection will begin soon. Unger & Unger, 126 Broadway, Brooklyn, are architects.

THE REFRACTORY *looks* AT THE JOB

BOILER furnace linings are subjected to severe wear and tear in plants operated at high capacity. Only special refractories can successfully resist high temperatures, slag penetration, abrasion and the corrosive action of coal ash slag. CRYSTOLON * Brick are considered by Norton Company to be excellent for meeting all these conditions. These heavy duty brick will give long, trouble-free service at the clinker line, in the bridge wall and front wall of coal-fired boiler furnaces.

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- 18 Different Types
- For Reduced Pressures up to 500 p.s.i.
- Sizes to 24"
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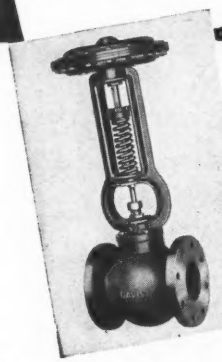
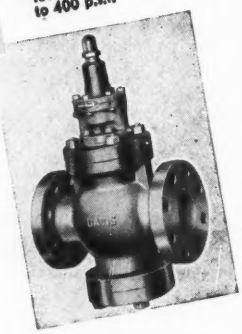
- Either Spring or Weight Loaded

DAVIS PRESSURE REGULATORS



Left: Davis No. 14 direct connected spring loaded regulator for steam, air, gas, water, oil. For pressures to 400 p.s.i. For reduced pressures 0 to 200 lbs.

Below: Davis No. 40 regulator for heavy duty, variable load conditions. Unaffected by high pressure fluctuations. Self-contained, pilot operated. For pressures to 400 p.s.i.



The complete Davis line includes a pressure regulator that will fit your requirements, whatever they are.

Davis *double seated balanced disc* regulators for continuous flow conditions.

Piston type, counterweighted, for pressures of 150 lbs. and less.

The *diaphragm type* for low service pressures.

For dead end service, a *single seated type* maintains pressure reduction irrespective of flow.

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Davis separate auxiliary control type has positive control of disc action, and gives dependable, accurate regulation under variable conditions.

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DAVIS REGULATOR CO.

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DAVIS VALVES

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N. C., Fayetteville—Water Dept., plans new elevated steel tank and tower in connection with extensions and improvements in municipal water system. Unit will have a capacity of 1,000,000 gal, and is estimated to cost approximately $140,000. Financing in part has been arranged through Federal aid.

N. C., Kinston—Electric Dept., has plans under way for extensions and improvements in municipal steam-electric generating station, with installation of equipment for increased capacity. Cost about $450,000. Proposed to begin work at early date.

N. C., Raleigh—Carolina Power & Light Co., Raleigh, has authorized fund of approximately $6,000,000 for expansion and improvements during coming year, including power plants, transmission and distribution lines, power substations and other facilities. A considerable part of fund will be used for extensions in rural electric system.

N. D., Lidgerwood—Junior Chamber of Commerce, Lidgerwood, is at head of project to construct and operate new municipal power station. Surveys and estimates of cost will be made. Proposed to use Diesel engine-generator units and accessories.

Ohio, Cincinnati—Hospital Dept., City Hall, has plans under way for extensions and improvements in power plant at General Hospital, Burnet Ave., with installation of new turbine-generator, boilers, stokers, feedwater heaters and auxiliary equipment. No estimate of cost announced. Samuel Hannaford & Sons, Dixie Terminal Bldg., are architects; Fosdick & Hilmer, Union Trust Bldg., are consulting engineers, both Cincinnati.

Ohio, Miamisburg—Municipal Light & Water Dept., has authorized surveys and estimates of cost for extensions and improvements in municipal steam-electric power plant, including installation of new generating unit, boiler and auxiliary equipment for increased capacity. Fosdick & Hilmer, Union Trust Bldg., Cincinnati, Ohio, are consulting engineers.

Okla., Barnsdall—Town Council plans new municipal power station and electrical distribution system. Proposed to use Diesel engine-generator unit and accessories. Financing has been arranged through Federal aid. Cost approximately $200,000.

Pa., Bradford—Public Works Dept., plans new motor-driven pumping plant, with controls and accessory equipment in connection with new interceptor sewage system and treatment plant. Entire project will cost about $548,000. Financing in part will be arranged through Federal aid.

S. D., Madison—Light & Power Dept., has plans under way for extensions and improvements in municipal power plant, including installation of new Diesel engine-generator unit of about 1600-kw rating and auxiliary equipment. Cost estimated about $180,000. Bond issue in that amount has been authorized.

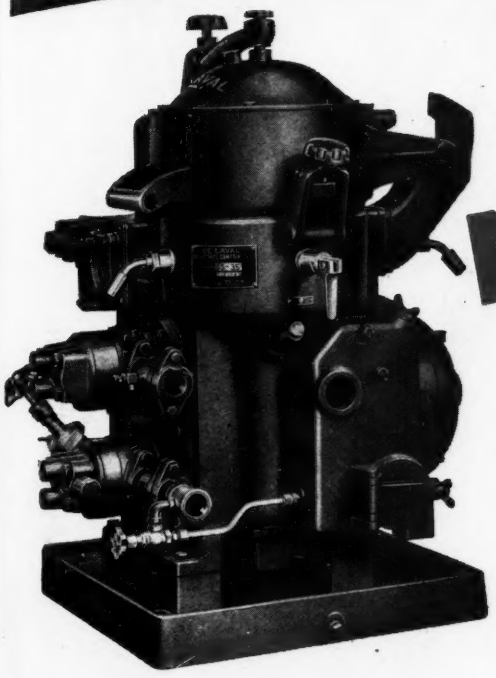
Texas, San Antonio—Public Service Board, 201 North St. Mary's St., has preliminary plans for expansion and improvements in steam-electric generating station on Mission Rd., with installation of new generator and auxiliary equipment, boiler and accessories. Cost estimated close to $2,000,000. Completion is scheduled in summer of 1948.

Texas—Sun Oil Co., 1608 Walnut St., Philadelphia, Pa., plans new natural gasoline plant in Sun oilfield area, South Texas, comprising several units, with processing equipment for large output. Project will include a compressor station, boiler house, pressure pipe lines for natural gas supply, steel tank storage units and other facilities. Cost reported over $750,000, with equipment. Proposed to begin work soon.

Va., Norfolk—Virginia Electric & Power Co., Richmond, Va., plans expansion and improvements in generating station on Reeves Ave., Norfolk, including installation of new turbine-generator, boilers and auxiliary equipment. Cost estimated close to $3,000,000. This will be part of 1946 extension program of company, which will include transmission and distributing lines, power substations and other facilities.

Clean Oil Means...

NO DIRT AND NO WATER!



WATER is just as much a trouble-maker for lubricating oil as dirt is. Frequently, as in the case of turbine oil, it is the ***chief*** offender—for condensate in turbine oil leads directly to the formation of sludge. And of course there is always the possibility that a sudden water leak might occur, and cause serious trouble through emulsification.

De Laval Oil Purifiers remove and continuously discharge any moisture that may get in the oil, whether it is a scant cupful per reservoir or that released by a more serious break. Oil purified by centrifugal force in the bowl of a De Laval machine is ***clean*** in the only sense that makes sense—it is free from ***liquid*** as well as solid impurities.

De Laval Oil Purifiers do not remove oil-soluble additives. Because action is wholly mechanical, there is no danger of such additives being lost in the purification process. This is an important advantage today.

De Laval Oil Purifiers keep oil so clean that its purity can best be compared with that of new oil.

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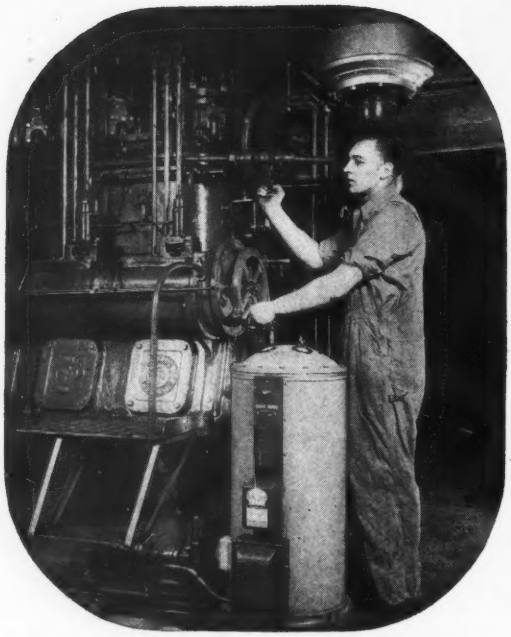

HONAN-CRANE OIL PURIFIERS
reduce operating costs . . .

● In many thousands of installations, Honan-Crane Purifiers are paying substantial dividends in reduced maintenance and operating costs of power generating equipment.

We quote below a typical report on the satisfactory performance of Honan-Crane equipment, received from Frank Keast, assistant plant superintendent, Armstrong Paint Co., 1330 Kilbourn Ave., Chicago, Ill.:

"One type of equipment that has more than paid its freight around here is the Honan-Crane oil purifier. We have four of them hooked up with our large Diesel engines. Before the purifiers were on the job we had to change oil every 500 hours. Now we keep on using the same oil. We find that the operation of Honan-Crane units not only keeps dirt and grit out of the engine bearings and simplifies maintenance, but saves us a good 25% on our lubrication costs."

● The Armstrong plant produces 5 million gallons of paint and varnish annually; operates a 250 kva GE turbine generator and a 500 hp Fairbanks-Morse 2 cycle Diesel generator at 250 volts in one engine room; three 400 hp Chicago-Pneumatic 4 cycle Diesel generators at 2300 volts in a second engine room.

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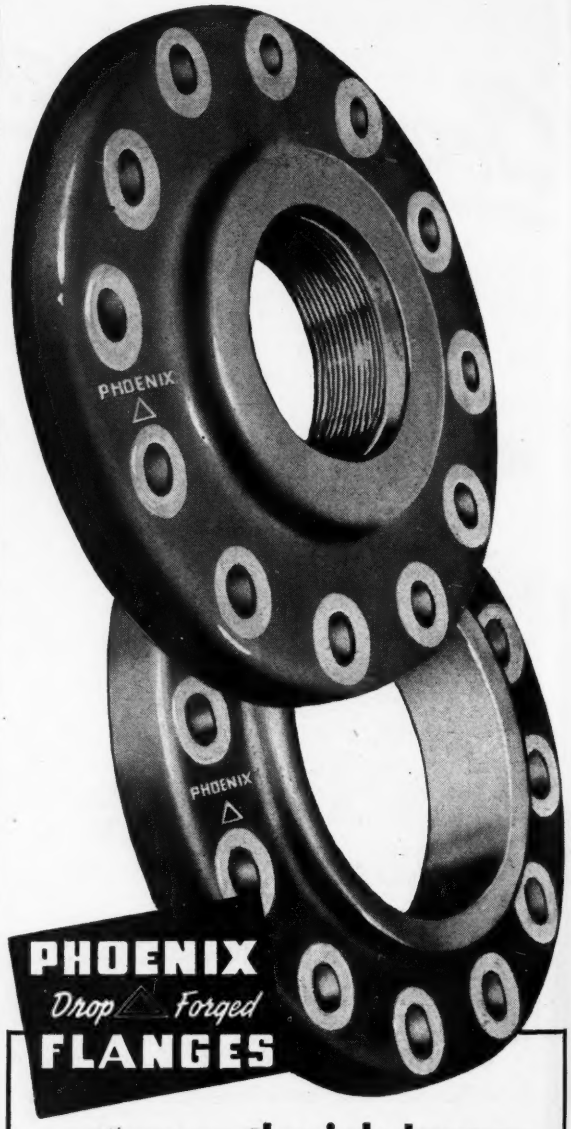

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FLANGES

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Phoenix Flanges are made of mild steel especially suited to welding and machining and are available in a wide range of styles and sizes. They can also be supplied in stainless steel, Everdur brass, and other alloys.

Every Phoenix Flange complies with ASA requirements and ASME and ASTM specifications.

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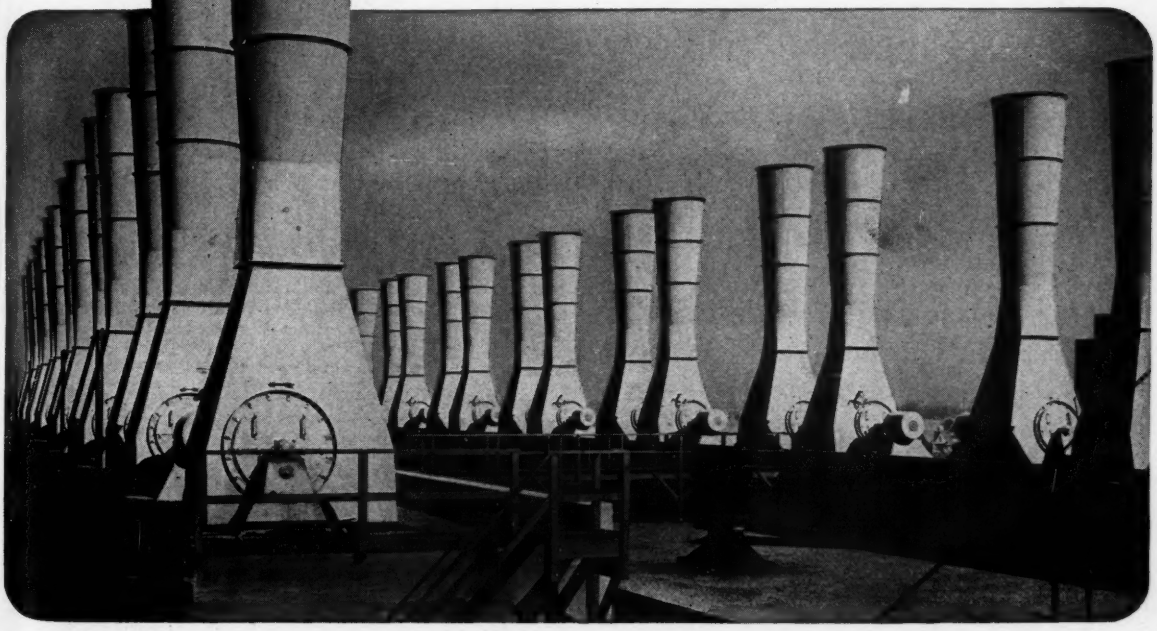
ELIMINATE UNNECESSARY POWER PLANT DRAFT LOSSES

LET THERMIX ENGINEERS PROVE HOW IT CAN BE DONE

Utmost power plant efficiency *demands* that fan, breeching and divergent stack be combined in a single compact unit in order to avoid resistances due to bends and sudden changes of section of duct work. This has been proved time and again by Thermix Fan Stack installations—in terms of hard cash savings in motor power consumption and in connection with almost any industry that might be mentioned.

Several years ago, for instance, the Schenley Distillers Corporation installed a single Thermix Stack by way of test. So great was the improvement that additional installations were quickly made!

Many similar cases prove beyond all question of doubt that power plants operating with old-style conventional draft equipment, consisting of a separate fan, breeching and stack, warrant an immediate investigation by Thermix field engineers and every new design of power plant should include this modern, economical method of draft production.



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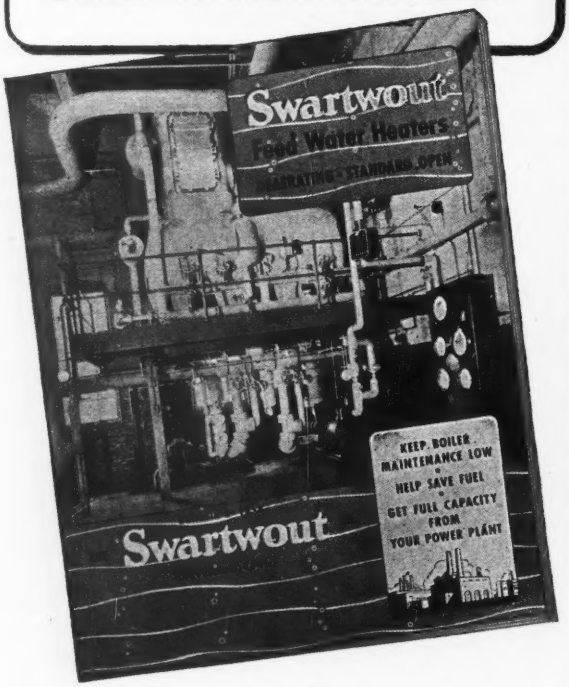

THIS NEW BULLETIN gives you in quick detail the story of the high efficiency thirty years of experience have brought to the designing and building of Swartwout Feed Water Heaters engineered to your needs.

● Prevent corrosion and reduce costly maintenance—save valuable fuel by efficient preheating. Swartwout Heaters, engineered to handle *your* feed water requirements, meet all tests, assure definite savings and life-time trouble-free service. *Write for Bulletin S-18-E today. No obligation.*

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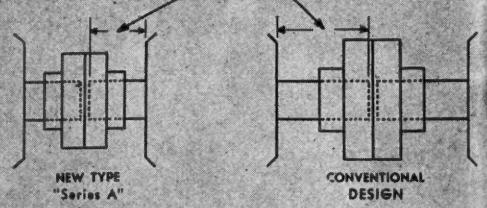
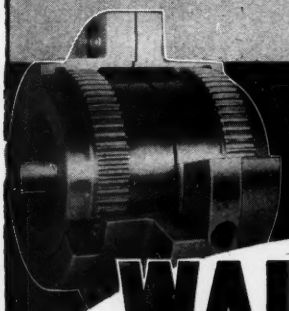
POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave. Cleveland 17, Ohio

No Wonder This New Coupling Design Has Made A Hit With Coupling Buyers

NOTICE THE IMPORTANT *Difference* IN LENGTH OF SHAFT





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It embodies all Waldron construction refinements. An all steel coupling that compensates for misalignment without adding stress to shaft or bearings.

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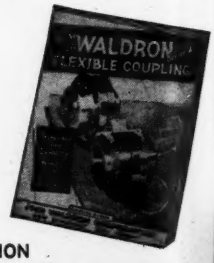

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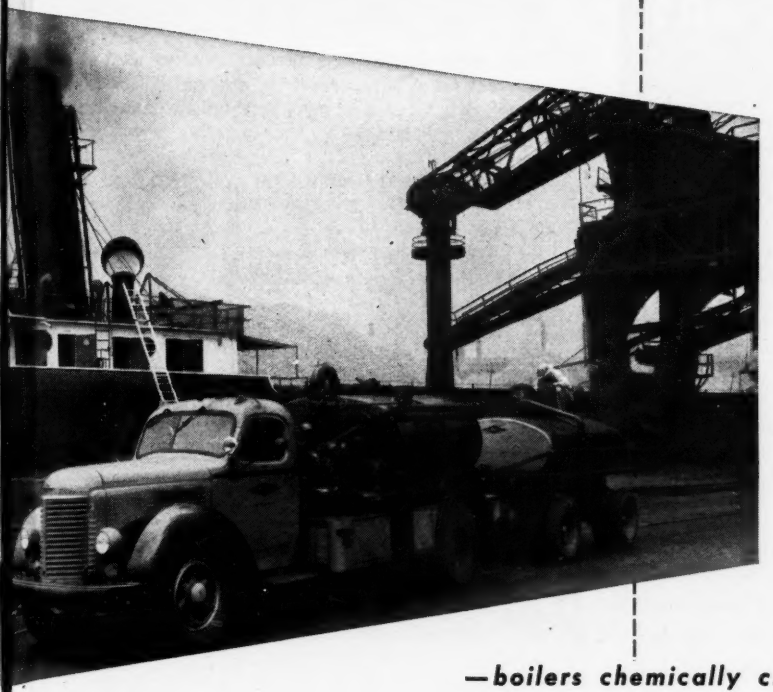

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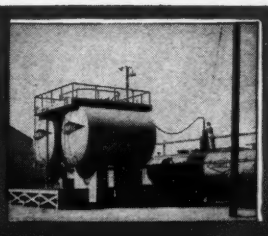
SPECIALISTS IN CHEMICAL CLEANING SERVICE



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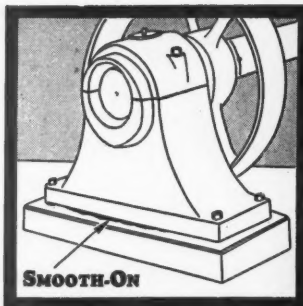

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Controlled, Two Stage Welding by the Westport Method now provides maximum bondage and strength at butt welded pipe joints, without "over-welding," which causes protrusion of weld metal on the inside of the pipe. The patented Westport Method assures a pipe contour smoother on the inside than on the outside, without the use of backing rings, which themselves have many disadvantages. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

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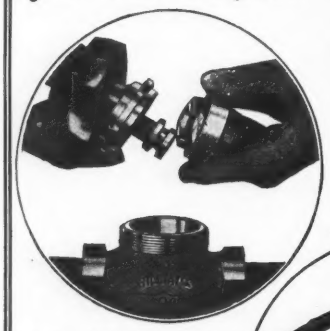
Use VULCODISC

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle — tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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To Protect Boiler Tubes Against Possible Pitting *Finish with*

MAGIC

BOILER PRESERVATIVE

SOME methods of water softening remove calcium and magnesium bicarbonate and calcium and magnesium sulphate, but do not remove certain insoluble salts which accumulate and form a hard scale.

Other methods take out the insoluble salts but introduce an equivalent amount of sodium salts. This may lead to pitting and alkali embrittlement.

In both cases, the safe rule is "Finish with Magic." It provides a colloidal film of protection on the surface of boiler metal that checks scale formation—guards against corrosion and pitting.

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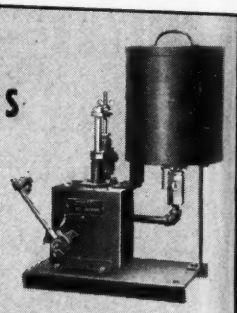
CHEMICAL FEEDERS



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ENGINEERING PROGRESS REPORT # 2

LJUNGSTROM AIR PREHEATER

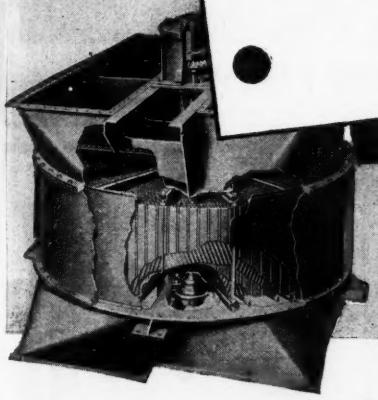
Economics of Fuel Saving by Lower Exit-Gas Temperatures

Mounting fuel costs stress the importance of savings made by lowering exit-gas temperatures, and thus increasing heat recovery. Problems arising from lower exit-gas temperatures are being given intensive study.

Progress report one covered control of deposits. Encouraging progress is being made toward the reduction of corrosion. At the present time, while it is not possible to eliminate corrosion, it can be held down to a low rate.

This leaves the entire subject of lower exit-gas temperatures on a strict dollars-and-cents basis. With the mass blower in use, increased draft loss caused by the deposits plugging up the heater is no longer a factor.

An exclusive feature of the Ljungstrom air preheater provides for rapid and inexpensive replacement of the elements at the cold end.



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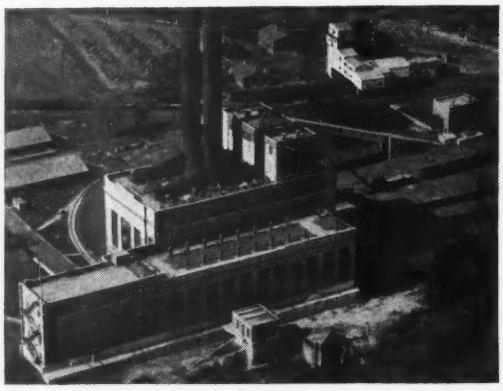

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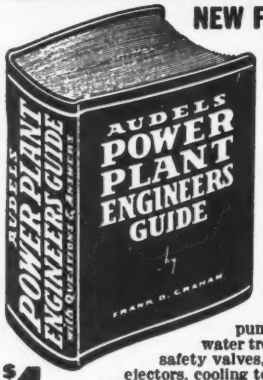
POWER PLANT ENGINEERS GUIDE
WITH QUESTIONS AND ANSWERS



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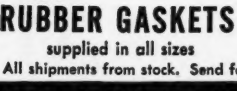

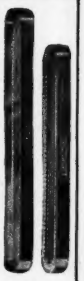

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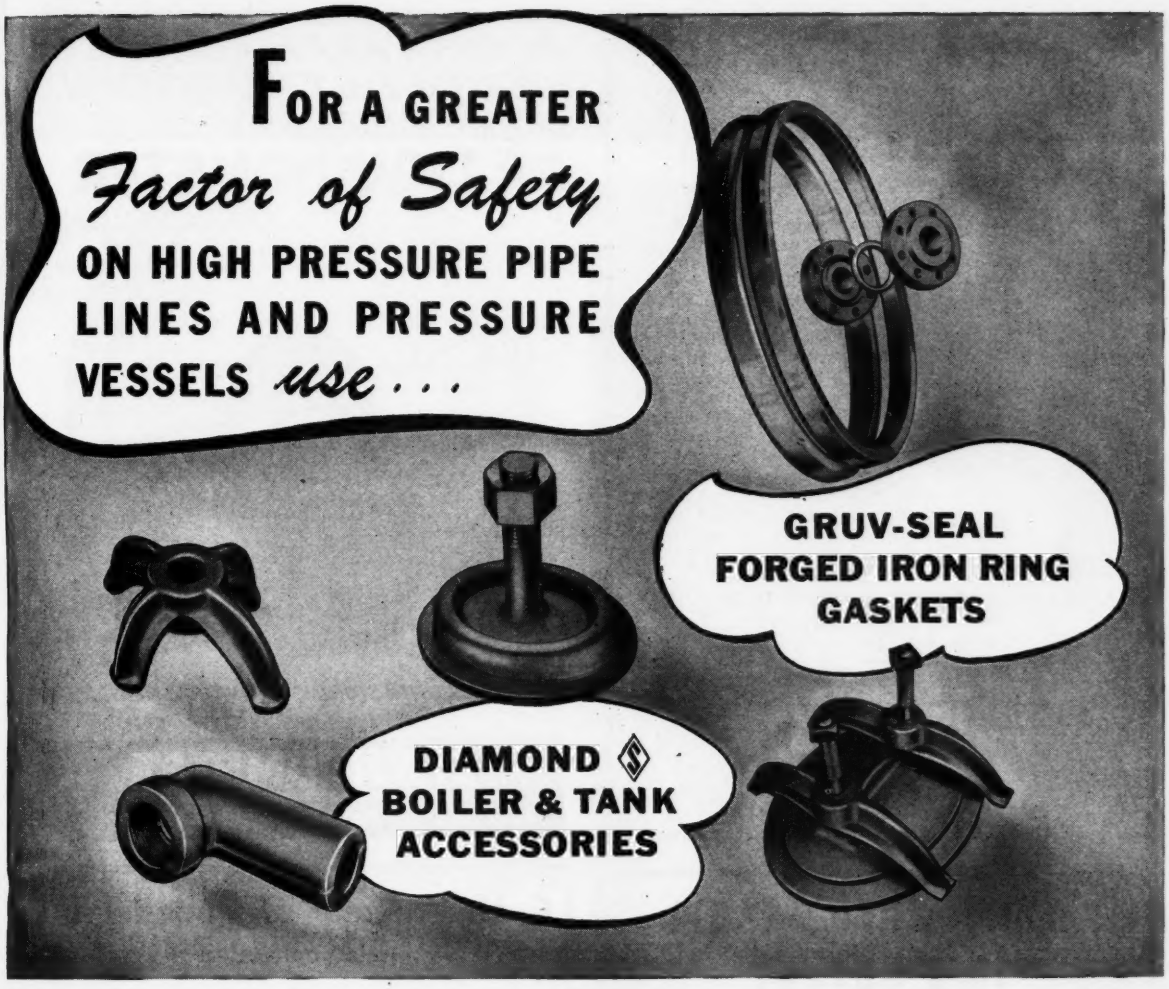
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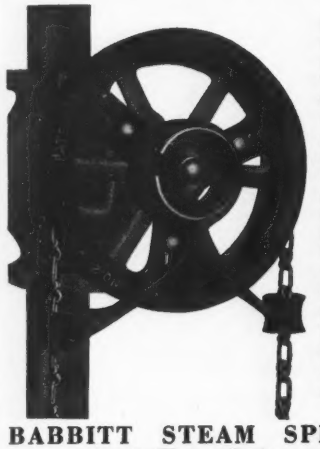

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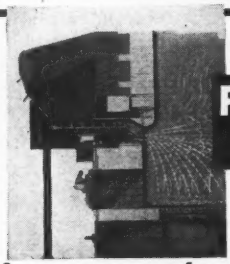

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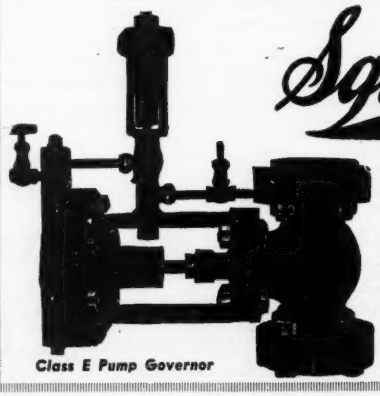

Class E Pump Governor

For True Regulation on Boiler Feed Pumps

The C. E. Squires Co.
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Catalog E-12 explains

FUEL FLEXIBILITY

THE MODERN SAFETY FACTOR

Modern design of steam generating equipment discards the old, tight, restricted fuel furnaces for new flexibility to burn the range of fuels economically available and to give the highest dollar efficiency for the life of the plant.

ONE DIMENSION—KEY TO FLEXIBILITY

One boiler manufacturer has standardized a popular type of pulverized-coal-fired unit, so that for a given steam-generating capacity at a specific pressure and steam temperature a definite arrangement of boiler and furnace will be suggested. Different grades of coal will, however, require varying amounts of heat-absorbing surface in the furnace to avoid slagging. Flexibility in this respect is provided by varying the furnace size ***merely by changing one dimension, the height of the furnace*** as shown by the shaded portion of the drawing.

THE DESIGN SPECIFICATION

Should include the critical characteristics of the range of coals which sound fuel planning forecasts as competitively available. Limited reserves of high quality fuels are seldom the best dollar value for generating steam and usually the poorest coals obtainable will not give the lowest steam cost. A proper fuel specification compromises between these limits to provide justifiable Fuel Flexibility.

FUEL FLEXIBILITY—*economically sound*

1. **Increased investment is normally less than 10% and can probably be amortized in fuel savings in less than one year.**
2. **Freedom in fuel purchasing permits the selection of the best current fuel value.**
3. **Changing market conditions demand fuel flexibility in furnace design.**
4. **Competitive over-all steam cost assured for the economic life of the plant.**

FAIRMONT COAL—The Fuel Investigation reveals that in most markets Fairmont Coal will continue to be an excellent value in the foreseeable future. Many Utilities and Industrials are using the characteristics of Fairmont Coal in their Fuel Design Specifications in order to insure proper Fuel Flexibility and low-cost steam for their new plants.

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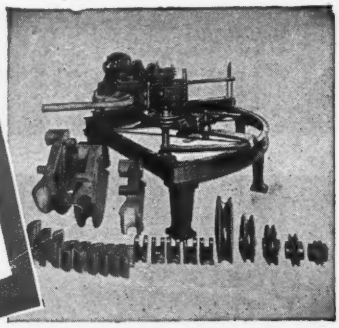

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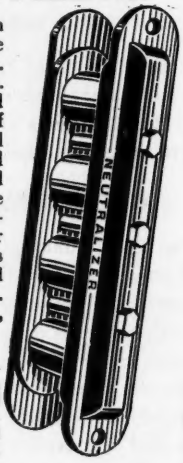

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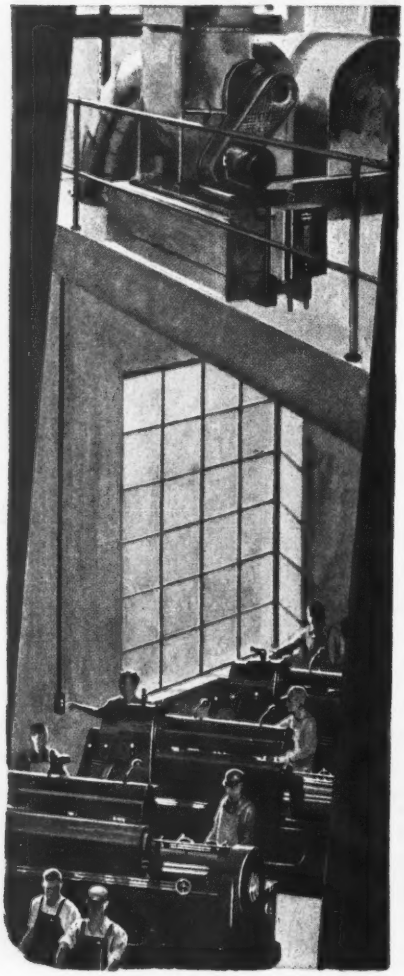

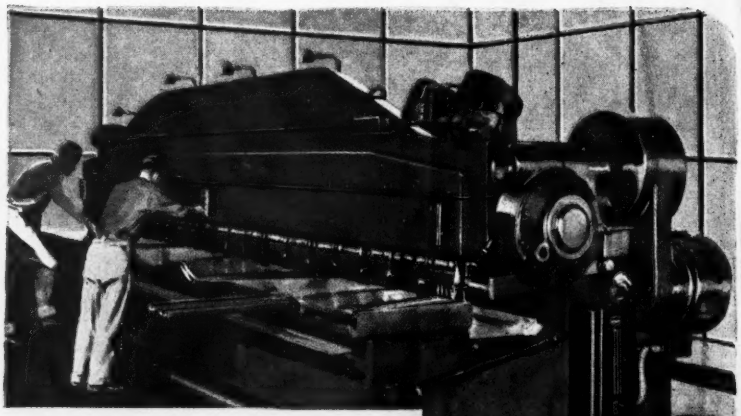

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